EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-01

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Operations Support for T&E Fac
	Base X Option Period Number	

Contractor: CB&I FEDERAL SERVICES LLC

Specify Section and paragraph of Contract SOW: Sec 3 Items 1-5 and Sec 3-1 and Sec 4

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full title: Facility Support Services to the EPA T&E Facility, Full Containment Facility, STREAMS Facility & Center Hill Facility

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (*Max 2*) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period: 06/01/2014 To 05/31/2015 — Cost/Fee: — LOE:

This Action:

Total:

Work Plan / Cost Estimate Approvals

Contractor WP Dated: — Cost/Fee: — LOE:

Cumulative Approved: — Cost/Fee: — LOE:

Work Assignment Manager Name: John Ireland (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7413 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
FACILITY SUPPORT SERVICES TO THE EPA T&E FACILITY, FULL CONTAINMENT FACILITY, STREAMS FACILITY, & CENTER HILL FACILITY
CONTRACT # EP-C-14-012
W.A. 0-01

PERIOD OF PERFORMANCE: June 1, 2014 through May 31, 2015

Specific Work Requirements
The Contractor shall provide labor and services necessary to support operation of the T&E Facility. Normal operating hours for T&E support staff will be Monday through Friday from 8:00 a.m. to 5:00 p.m. The Facility shall be closed during normal EPA scheduled holidays. Required technical support extending beyond the established schedule for facility operations or specific projects will be discussed with the Contract Level Contracting Officer Representative (CL-COR) and/or Work Assignment Contracting Officer Representative (WACOR) and specified as technical direction for the individual work assignments.

The Contractor shall operate in accordance with the NRMRL Standard Operating Procedures Manual (SOP). This SOP describes routine operational and staffing arrangements of the facility, details basic information pertaining to the conduct of routine testing, and describes required activities and associated records concerning facility maintenance, security, safety, and continual compliance with all applicable environmental protection permits and regulations

The Contractor shall not perform O&M services, janitorial services, or guard service for the building. However, the Contractor shall perform maintenance and housekeeping of experimental and laboratory equipment, bench- and pilot-scale work areas, and the high bay research experimental work areas, which are part of the research systems, and maintain a safe and healthful working environment in the experimental work areas.

With respect to "maintaining building security", EPA provides weekend, holiday, and evening (6:00 PM to 6:00 AM) guard services. Guards shall be notified of any after hour visitors and all after hour visitors shall sign-in and out at the guard's check point at the T&E Facility. After normal business hours, the Contractor personnel shall be admitted with proper government identification

In the general day-to-day technical operation of the T&E Facility, the contractor shall perform the following functions:

1. Maintain adequate inventories of health and safety supplies necessary to support all facility research operations.

2. Maintain a centralized supply of up-to-date T&E Facility information packages and disposable visitor safety glasses.

3. Schedule the maintenance and maintain a maintenance log for repair of project and facility related equipment, laboratory instruments, and work tools.

4. Develop and maintain a project-specific and facility-wide on-site hazardous waste tracking protocol and records relevant to Ohio EPA RCRA compliance reporting requirements.

5. Assure compliance with all environmental and health and safety requirements, as well as with all operation permits which the Facility or work assignments may hold.

6. Coordinate shipping and receiving and pick-up and return of work assignment specific equipment, supplies and samples necessary to support facility research operations.

7. Assist SHEM with hazardous waste manifesting (incoming and outgoing shipments) to ensure accuracy of shipping documents and compliance with regulatory requirements

8. Facilitate and schedule the transportation of "treatability samples" and, in the process, ensure DOT regulatory compliance.

9. Design, fabricate, assemble and disassemble general purpose equipment for multiple purpose experimental usage.

10. Provide specialized machine shop, welding, plumbing, electronic fabrication expertise for facility support and for research studies.

11. Provide specialized electronic and electric equipment analysis and troubleshooting, design, installation, operation and maintenance.

12. Troubleshoot machine shop problems and maintain the equipment and supplies. Schedule periodic maintenance and maintain a maintenance log for repair and servicing of machine shop tools.

13. Manage general use laboratory equipment, supplies and chemicals and purge outdated chemicals and supplies when needed.

14. Inspect hazardous waste storage tanks and drum storage areas, and exercise the Facility's effluent control valve according to the facility's Ohio EPA Director's Exemption.

15. Inspect waste and influent feed supplies and other project specific high bay, bench-and pilot-scale utilities. Inspect effluent and waste discharges and other project specific high bay, bench-and pilot-scale utilities.

16. Calibrate and/or maintain general use laboratory analytical equipment and high bay monitoring sensors, scales, refrigerators, fume-hoods, furnaces, and instruments.

17. Make specific minor adjustments to experimental equipment as required by the EPA research work assignment contracting officer representative (WACOR).

18. Ensure and maintain the safety and security of research project areas and all tools, utilities and all equipment. Replace worn common hand/work tools, accessories, and equipment as needed.

19. Perform daily housekeeping within the experimental areas in the pilot-scale high bay, the bench-scale study lab, all chemistry labs, the machine shop area and other experimental areas. At the end of a scheduled work day, the Contractor shall insure that work areas are clean of specific debris, tools, and trash. The work area trash collection containers shall be made available for pick-up by the EPA on-site "Housekeeping" Contractor. The pick-up area shall be the yellow taped walkway area. At the start of the work day the Contractor shall insure the trash collection containers are available in the work area. During the normal work day the Contractor is responsible for emptying the trash collection containers into an appropriate collection bin.

20. Maintain chemical inventory, lock-out tag-out, and Right-to-Know records, references, and displays. Provide as-needed labeling and marking of equipment and supplies for chemical inventory and right-to-know records and displays. Maintain ladder, lanyard and harness, elevator, crane and accessories, and fork-truck inspection and operational logs.

21. Provide expert consultation on T&E experimentally-specific hazardous waste manifesting, importing, transportation, disposal, etc.

22. Provide consultation and coordinate with SHEM on Resource Conservation & Recovery Act (RCRA), Superfund Amendments and Reauthorization Act of 1986 (SARA), Occupational Safety and Health Administration (OSHA), Department of Transportation (DOT), Metropolitan Sewer District (MSD), Safe Drinking Water Act Amendments (SDWAA), US Environmental Protection Agency (USEPA), Ohio Environmental Protection Agency (OEPA), City of Cincinnati, Hamilton County and any other regulatory requirements which are specific to the operation of experimental systems at the T&E Facility.

23. Prepare or assist in preparation of hazardous waste manifest documents for research related wastes shipped into and from the T&E Facility. The EPA Facility Manager or other designated EPA SHEM employee shall approve/sign manifests.

24. Prepare or assist SHEM in preparation of required T&E Facility annual hazardous waste management, hazardous waste generator, waste minimization, small quantity treatability, MSD industrial user and other required periodic reports.

25. Provide input for achieving and maintaining acceptable engineering controls and health and safety conditions for general facility and research operations, outside storage areas, fabricating, welding and cutting areas and including the machine shop.

26. Provide input for the cleanup of chemical spills and information on emergency response.

27. Assist with in-house and extramural inspections, presentations and tours. This could include project descriptions, posters and oral presentations.

28. Identify, collect, package, and report unused equipment, instruments and materials which may be either scrapped or placed in EPA off-site storage or excess in order to minimize unnecessary storage and unnecessary hoarding. The Contractor shall maintain an electronic tracking system for the items placed in excess and storage.

29. Develop within two weeks of all work plan approvals a "Project Board" and a single page abbreviated project description. Both exhibits are to be kept up to date. They are to be charged to the respective work assignments.

30. Provide other support and services of a facility-wide nature which are not specifically mentioned or detailed herein but are related to requirements specified in the subject contract statement of work.

31. Provide annual RCRA refresher training for all T&E Facility personnel in accordance with the OEPA Director's Exemption requirements and hazardous waste regulations.

SUPPORT TO OTHER NRMRL CINCINNATI SATELLITE FACILITIES

In addition to the T&E Facility, the NRMRL also operates research projects at the Center Hill facility in Cincinnati, the Experimental Streams Research Facility in Milford, Ohio, and a small laboratory annex to the main Andrew W. Breidenbach Environmental Research Center (AWBERC-Cincinnati) building known as the Full-Containment Facility. These three locations will henceforth be referred to as the "Facility".

In the general day-to-day technical operation of the Facility and support of all Facility research operations, the Contractor shall perform any or all of the functions itemized above on a case-by-case basis as provided for via technical direction from the EPA WACOR.

We do not anticipate the need for any dedicated contractor staff to be located at these ancillary facilities

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-03

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015 Base X Option Period Number	Detention Basin Retrofit Techn

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec 3, #1; Sec 5

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full title: Detention Basin Retrofit Technology

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SFO (Max 2) ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

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Authorized Work Assignment Ceiling

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06/01/2014 To 05/31/2015		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee:	LOE:
Cumulative Approved:	Cost/Fee:	LOE:

Work Assignment Manager Name James Goodrich (Signature) (Date)	Branch/Mail Code: Phone Number 513-569-7605 FAX Number:
Project Officer Name Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: **0-03**

Title:
Detention Basin Retrofit Technology

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Dr. James A. Goodrich
Water Infrastructure Protection Division
U.S. EPA National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-569-7605

ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Craig Patterson
Water Quality Management Branch
Water Supply and Water Resources Division
U.S. EPA National Risk Management Research Laboratory
Cincinnati, Ohio 45268
Phone: 513-487-2805

Period of Performance:
June 1, 2014 to May 31, 2015

OBJECTIVE:
The objective of this Work Assignment shall be the development, deployment, and testing of a water quality treatment system/apparatus that can be integrated into the patent pending *Detain-H20* Detention Pond Retrofit Device. Detention ponds are nearly ubiquitous across the United States. Within one 36 square mile watershed in Northern Kentucky there are an estimated 535 existing detention ponds with over 2000 total identified in the three Northern Kentucky counties. The *Detain-H20* device was initially designed and built to only control the detention pond outflow rate below the critical flow threshold (Qcritical) in order to reduce downstream erosion. However, future Federal or State stormwater regulations are likely to require some level of water quality improvement. In terms of water quality criteria, the Kentucky Division of Water currently requires a water quality volume approach in SD1's stormwater permit. In SD1's corresponding Rules and Regulations for new development, the first 0.8 inches of rainfall (the 80th percentile event) must pass through a water quality BMP before being discharged from the site. Theoretically, there may be some level of water quality improvement within a detention pond due to the stormwater being held promoting particle settlement and biological uptake. However, as shown by data collected under the previous *Detain-H20* project, typical detention ponds provide little detention time with stormwater passing quickly downstream for most storm events. Although the *Detain-H20* device will increase the residence time and reduce sediment in the water column to some degree, there still exists the need to reduce dissolved water quality contaminants such as synthetic and volatile organic contaminants from roads, vehicles, and

emission exhaust as well as pesticides and fertilizers from agricultural and residential applications. A full-scale patent pending prototype is in-place at the project site. Currently, it is only capable of providing reductions in outflow rates in order to reduce downstream erosion of the channel bed and bank (Figure 1). For a more expeditious evaluation of water quality filtration media relative to real-world flow rates, pressure, and contact time, a pilot-scale experimental apparatus has been constructed at the USEPA Test & Evaluation Facility located in Cincinnati, Ohio

Figure 1. *Detain H2O* Site Installation

Technical Support

The contractor shall provide technical support to modify and improve the *Detain-H20* device by adding a media filtration treatment apparatus and real-time flow control. This project will provide water quality benefits by optimally matching water quality filtration/adsorption with nearby land use and storm event characterization, thereby minimizing the effects of land use and climate change on watershed hydrology. Stormwater will not only be temporarily detained, but multiple stormwater pollutants will be mitigated that are likely to include nutrients, pesticides, and roadway runoff. Filtration media to be considered range from natural products such as mulch, sand, and gravel to various grades of granular activated carbon and other manufactured media designed for specific classes of contaminants. Technical Direction will be used and supplied by the WACOR when needed, unless it increases the LOE or costs on this work assignment. If so, the work assignment will be amended.

Project activities include the development, deployment, and testing of a water quality treatment system/apparatus that can be integrated into the *Detain-H20* Detention Pond Retrofit Device. The *Detain-H20* device will be modified and improved by adding a multi-media filtration treatment system/apparatus with real-time flow rate control. The project will:

- Analyze the detention pond water quality and *Detain H2O* performance pre- and post-installation of selected filtration media throughout the Performance Period,
- Evaluate multiple media at the T&E Facility Detention Pond experimental pad,
- Modify the *Detain-H20* device in the field to include filtration, and

- Install and test real-time monitoring/control equipment.

A large bench-scale testing unit at the EPA T&E Facility has been developed (Figure 2). The bench-scale device will simulate the field installation. The contractor shall support in designing and performing experimental bench-scale studies on various filter media to be incorporated into the outflow devices at EPA's T&E facility. Initially, the flow rate through the pipe will be determined as a function of pressure (10 ft. H2O maximum pressure) with no restriction (media) in the pipe. The flow/pressure control valves will then be gradually closed to reduce the pressure in the pipe while the flow rate is recorded. Following the generation of the flow rate vs. pressure curve, a flow restrictor will be inserted into the Test Media section of the bench-scale device. Various types of media (sand, gravel, mulch, granular activated carbon, resins) will be evaluated in the bench-scale system. Flow rate vs. pressure curves (10 ft. H2O maximum pressure) will be generated for each of the media in the same manner as the initial testing.

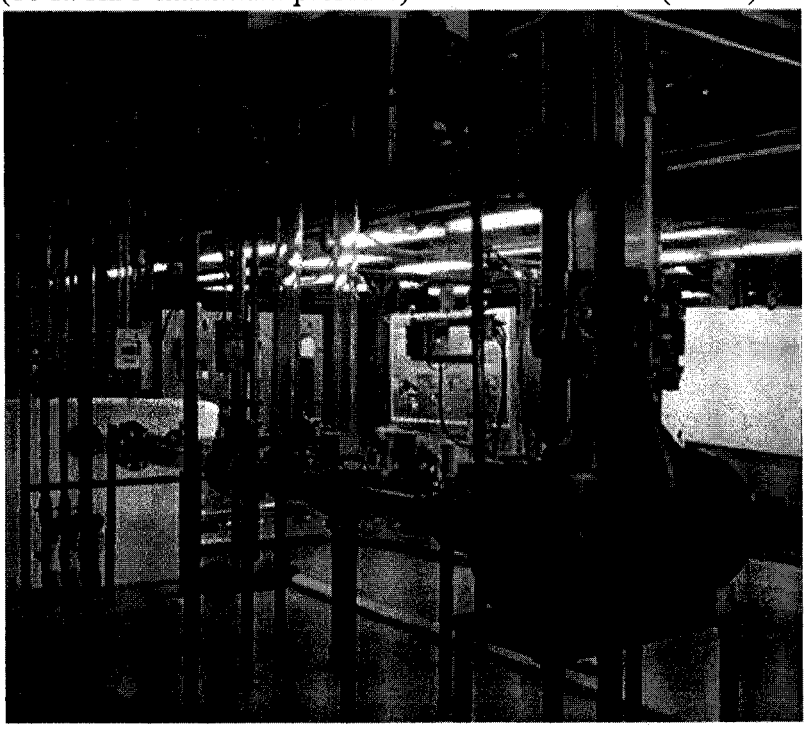

Figure 2. Experimental Detention Pond at T&E Facility

Following the T&E Facility evaluations, a filtration media apparatus shall be designed and installed on-site in conjunction with the *Detain-H2O* device. The contractor shall provide field sampling and analyses of hydrologic and water quality parameters at the field site prior to and following installation of the filtration system.

A real-time flow control system shall be investigated and designed. Under the technical direction of the WACOR, the contractor shall assist EPA in developing the project deliverables. There can be instances in which additional testing with these or other experimental devices can be required as directed by the WACOR. Upon completion of each set of experiments, the contractor shall provide the experimental data and results in a proper format. Specific Technical Support tasks are described below.

Task 1: Development of Work Plan

A work plan to complete the tasks outlined in this performance work statement shall be prepared and submitted in accordance with the contractual schedule for this deliverable. The proposed work plan shall set the contractor's approach, staffing, schedule, milestones, and estimated budget for the completion of tasks.

Task 2: Modification of QAPP and HASP

An EPA approved Quality Assurance Project Plan (QAPP) shall be developed. All procedures as identified in the EPA approved Standard Operating Procedures for experimental testing and analysis shall be utilized. As directed by the Principal Investigator, revisions or amendments to the QAPP may be per technical direction provided by the Principal Investigator. An EPA approved Health and Safety Plan (HASP) shall be developed.

Task 3: Field Water Quality and Device Performance

Field sampling will take place at the:

- Stormwater pipe draining the truck parking lot
- Stormwater pipe draining the roof
- Pool before the retrofit device
- Outlet of retrofit device

The analytical parameters:

- TSS
- Ammonium (NH_4^{+})
- Nitrate + Nitrate (NH_3^{-} +NO_2^{-})
- Total Nitrogen (TN)
- Total Phosphorous (TP)
- Dissolved Reactive Phosphorous (DRP)
- Metals – RCRA 8 metal without mercury
- Total Petroleum Hydrocarbon (TPH) – GRO and DRO
- Semi Volatile Organic Compounds (SVOC)
- E.coli

Three grab samples per rain event should be collected trying to catch the first flush. At least two separate storm events should be captured with a rain event in excess of 0.5 inches.

Task 4: Bench-scale Filtration Media Evaluations

Concurrently, the bench-scale evaluations will test two retrofit devices simultaneously. Parameters to be measured during the tests are the following:

- Flow rate
- Pressure
- Water quality in/out parameters as identified above in Task 3.

The flow rate, water quality performance, and the pressure will be measured for each retrofit device. The following media will be evaluated:

- No media

- Various grades of Sand/Gravel
- Biodegradable media such as Mulch
- Specific manufactured resins/Granular Activated Carbon

Following bench-scale evaluations, EPA shall select the media to be installed at the detention pond.

Task 5: Field Installation and Monitoring of Modified Detain H2O Filtration System

The Contractor shall help design, fabricate and install the filtration unit on-site in conjunction with the Project Partners and assist in water quantity/quality monitoring and monitor the performance of the new *Detain H2O* system.

Task 6: Real-Time Flow Control

Following the addition of the filtration technology being installed on-site, real-time flow rate control will be applied to the *Detain-H20* device in order to match the needed valve closure (flow rate reduction) with storm event intensity and duration. The *Detain-H20* device is currently configured with only a fixed plate with which to reduce the flow rate by a pre-set amount (e.g. 25%, 50%, or 75%). In order to optimally match the detention pond holding time with the particular storm event, a "smart" controllable valve linked to a precipitation gauge and weather radar shall be integrated into the *Detain-H20* device. A second, smaller device located at another detention pond may be required for this task.

Contract Management and Reporting

The contractor shall:

- Follow all procedures as identified in the EPA approved Standard Operating Procedures for the experimental testing and analysis.
- Provide technical support in the set-up, troubleshooting, and maintenance of the detention pond outflow devices as identified within this statement of work and/or as directed through written technical direction provided by the WACOR.
- Maintain an effective communication with EPA on testing maintenance, as well as support to on-site EPA project personnel.
- Follow the EPA-approved QAPP to complement EPA research tasks conducted at the EPA Test and Evaluation Facility, field, or at contractor's own research facilities.
- Revise or amend as necessary the Quality Assurance Project Plan (QAPP) for specific experimental work plans on a series of experimental testing per technical direction provided by the WACOR.

- Project progress, results and highlights shall be summarized based on research findings. The contractor shall provide a Draft Interim Summary Report on or before May 10, 2013.

- After addressing the WACOR's comments, the contractor shall provide a Draft Final Interim Summary Report by May 31, 2015.

Monthly Reports and Meetings

Monthly Reports

Monthly reports summarizing the status of the Work Assignment shall be completed and provided to the EPA CL-COR as part of the Work Assignment deliverables. The monthly reports shall:

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks,

- Itemize and track separately the budgets and level of efforts for the Tasks,

- Summarize the planned activities anticipated for the upcoming period,

- Identify problems encountered and resolutions.

Project Support Maintenance Meetings

Project meetings shall be conducted as needed to assure the completion of the project tasks as proposed and approved. The contractor shall provide at a minimum the following information: planned project activities for the upcoming reporting period, problems encountered and resolutions and budget information.

The contractor shall provide the WACOR all project management information in hard copy and electronic format. The contractor shall summarize project meetings and submit to the WACOR and the PO in the most up-to-date version of Microsoft Word format within five (5) working days of the project and research collaboration meetings. Summary of the meetings shall be provided to the EPA via E-mail.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-03

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Detention Basin Retrofit Techn
	Base X Option Period Number	

Contractor: CB&I FEDERAL SERVICES LLC

Specify Section and paragraph of Contract SOW: Pg 1-4 Section 4, Paragraph 1, Page 1-11 Section 5

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full Title: Detention Basin Retrofit Technology. The purpose of this amendment is to add Task 7 to the work assignment.

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

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Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 06/01/2014 To 05/31/2015		
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Work Plan / Cost Estimate Approvals

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PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: **0-03**
Amendment # 1

This amendment only adds Task 7 to the work assignment. Nothing else is affected in this work assignment from this amendment.

Title:
Detention Basin Retrofit Technology

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Dr. James A. Goodrich
Water Infrastructure Protection Division
U.S. EPA National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-569-7605

ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Craig Patterson
Water Quality Management Branch
Water Supply and Water Resources Division
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ponds provide little detention time with stormwater passing quickly downstream for most storm events. Although the *Detain-H20* device will increase the residence time and reduce sediment in the water column to some degree, there still exists the need to reduce dissolved water quality contaminants such as synthetic and volatile organic contaminants from roads, vehicles, and emission exhaust as well as pesticides and fertilizers from agricultural and residential applications. A full-scale patent pending prototype is in-place at the project site. Currently, it is only capable of providing reductions in outflow rates in order to reduce downstream erosion of the channel bed and bank (Figure 1). For a more expeditious evaluation of water quality filtration media relative to real-world flow rates, pressure, and contact time, a pilot-scale experimental apparatus has been constructed at the USEPA Test & Evaluation Facility located in Cincinnati, Ohio

Figure 1. *Detain H2O* Site Installation

Technical Support

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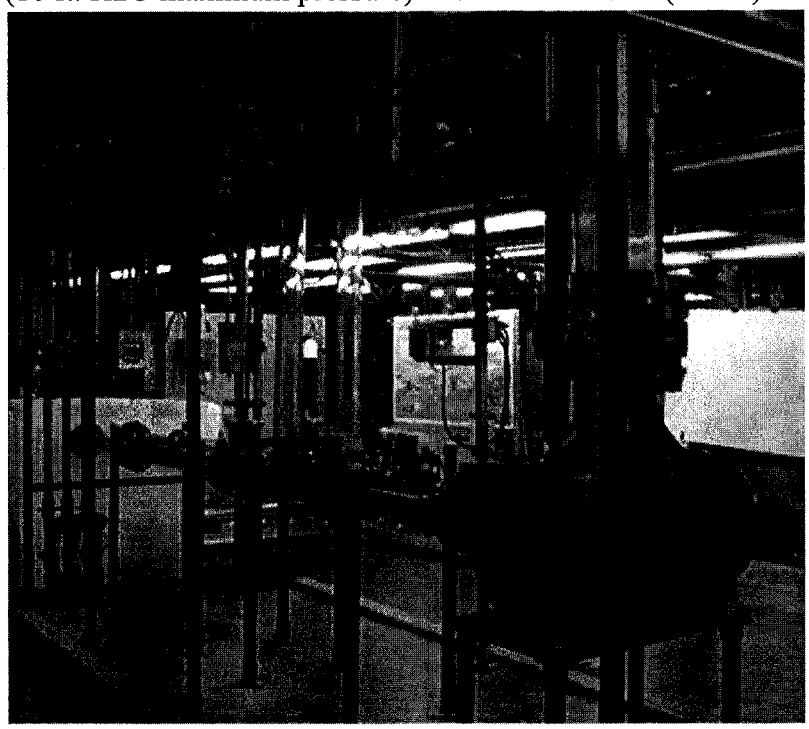

Figure 2. Experimental Detention Pond at T&E Facility

Following the T&E Facility evaluations, a filtration media apparatus shall be designed and installed on-site in conjunction with the *Detain-H2O* device. The contractor shall provide field sampling and analyses of hydrologic and water quality parameters at the field site prior to and following installation of the filtration system.

A real-time flow control system shall be investigated and designed. Under the technical direction of the WACOR, the contractor shall assist EPA in developing the project deliverables. There can be instances in which additional testing with these or other experimental devices can be required as directed by the WACOR. Upon completion of each set of experiments, the contractor shall provide the experimental data and results in a proper format. Specific Technical Support tasks are described below.

Task 1: Development of Work Plan

A work plan to complete the tasks outlined in this performance work statement shall be prepared and submitted in accordance with the contractual schedule for this deliverable. The proposed work plan shall set the contractor's approach, staffing, schedule, milestones, and estimated budget for the completion of tasks.

Task 2: Modification of QAPP and HASP

An EPA approved Quality Assurance Project Plan (QAPP) shall be developed. All procedures as identified in the EPA approved Standard Operating Procedures for experimental testing and analysis shall be utilized. As directed by the Principal Investigator, revisions or amendments to the QAPP may be per technical direction provided by the Principal Investigator. An EPA approved Health and Safety Plan (HASP) shall be developed.

Task 3: Field Water Quality and Device Performance

Field sampling will take place at the:

- Stormwater pipe draining the truck parking lot
- Stormwater pipe draining the roof
- Pool before the retrofit device
- Outlet of retrofit device

The analytical parameters:

- TSS
- Ammonium (NH_4^{+})
- Nitrate + Nitrate (NH_3^{-} +NO_2^{-})
- Total Nitrogen (TN)
- Total Phosphorous (TP)
- Dissolved Reactive Phosphorous (DRP)
- Metals – RCRA 8 metal without mercury
- Total Petroleum Hydrocarbon (TPH) – GRO and DRO
- Semi Volatile Organic Compounds (SVOC)
- E.coli

Three grab samples per rain event should be collected trying to catch the first flush. At least two separate storm events should be captured with a rain event in excess of 0.5 inches.

Task 4: Bench-scale Filtration Media Evaluations

Concurrently, the bench-scale evaluations will test two retrofit devices simultaneously. Parameters to be measured during the tests are the following:

- Flow rate
- Pressure
- Water quality in/out parameters as identified above in Task 3.

The flow rate, water quality performance, and the pressure will be measured for each retrofit device. The following media will be evaluated:

- No media
- Various grades of Sand/Gravel
- Biodegradable media such as Mulch
- Specific manufactured resins/Granular Activated Carbon

Following bench-scale evaluations, EPA shall select the media to be installed at the detention pond.

Task 5: Field Installation and Monitoring of Modified Detain H2O Filtration System

The Contractor shall help design, fabricate and install the filtration unit on-site in conjunction with the Project Partners and assist in water quantity/quality monitoring and monitor the performance of the new *Detain H2O* system.

Task 6: Real-Time Flow Control

Following the addition of the filtration technology being installed on-site, real-time flow rate control will be applied to the *Detain-H20* device in order to match the needed valve closure (flow rate reduction) with storm event intensity and duration. The *Detain-H20* device is currently configured with only a fixed plate with which to reduce the flow rate by a pre-set amount (e.g. 25%, 50%, or 75%). In order to optimally match the detention pond holding time with the particular storm event, a "smart" controllable valve linked to a precipitation gauge and weather radar shall be integrated into the *Detain-H20* device. A second, smaller device located at another detention pond may be required for this task.

Task 7: Mobile Detention Device Display Model

There are an increasing number of requests for information and demonstrations of the *Detain-H2O* device and a mobile display unit needs to be fabricated. The contractor shall help design and fabricate the mobile display with the Project Partners. The footprint should be approximately 4' x 6' to allow for ease of transportation and display at any meeting venue such as a building lobby, conference room, or exhibit hall. The Display should have at a minimum: an accurate scale model of the *Detain-H2O* device, poster, and video of the device in operation. A handout should be developed consistent with the Poster. The mobile display should also have the ability to store handouts for distribution. The final design shall be approved by the WACOR.

Contract Management and Reporting

The contractor shall:

- Follow all procedures as identified in the EPA approved Standard Operating Procedures for the experimental testing and analysis.

- Provide technical support in the set-up, troubleshooting, and maintenance of the detention pond outflow devices as identified within this statement of work and/or as directed through written technical direction provided by the WACOR.

- Maintain an effective communication with EPA on testing maintenance, as well as support to on-site EPA project personnel.

- Follow the EPA-approved QAPP to complement EPA research tasks conducted at the EPA Test and Evaluation Facility, field, or at contractor's own research facilities.

- Revise or amend as necessary the Quality Assurance Project Plan (QAPP) for specific experimental work plans on a series of experimental testing per technical direction provided by the WACOR.

- Project progress, results and highlights shall be summarized based on research findings. The contractor shall provide a Draft Interim Summary Report on or before May 10, 2013.

- After addressing the WACOR's comments, the contractor shall provide a Draft Final Interim Summary Report by May 31, 2015.

Monthly Reports and Meetings

Monthly Reports

Monthly reports summarizing the status of the Work Assignment shall be completed and provided to the EPA CL-COR as part of the Work Assignment deliverables. The monthly reports shall:

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks,

- Itemize and track separately the budgets and level of efforts for the Tasks,

- Summarize the planned activities anticipated for the upcoming period,

- Identify problems encountered and resolutions.

Project Support Maintenance Meetings

Project meetings shall be conducted as needed to assure the completion of the project tasks as proposed and approved. The contractor shall provide at a minimum the following information:

planned project activities for the upcoming reporting period, problems encountered and resolutions and budget information.

The contractor shall provide the WACOR all project management information in hard copy and electronic format. The contractor shall summarize project meetings and submit to the WACOR and the PO in the most up-to-date version of Microsoft Word format within five (5) working days of the project and research collaboration meetings. Summary of the meetings shall be provided to the EPA via E-mail.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-05

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015 Base X Option Period Number	Membrane Tech for Env Separati

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec 3 Items 1-5

Purpose:
- ☒ Work Assignment
- ☐ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full Title: Membrane Technologies for Environmental Separations

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2015		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name Leland Vane (Signature) (Date)	Branch/Mail Code: Phone Number 513-569-7799 FAX Number: 513-569-7677
Project Officer Name Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
(WA 00-05, Contract EP-C-14-012)

Title: Membrane Technologies For Environmental Separations

Work Assignment Contracting Officer Representative (WACOR):

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Background

As industries move to incorporate pollution prevention principles into their production processes and attempt to remediate or recover resources from existing contaminated sites and waste streams, new cost-effective separation technologies are needed. In addition, for process retrofits, these separation technologies must be easily integrated into existing plant designs. Membrane technologies can be utilized to separate, fractionate, and concentrate contaminants or process components. In general, they require minimal temperature changes and chemical addition, operate in either continuous or batch modes, use significantly less energy than traditional separation processes, do not alter the chemical structure of the processed materials, and are easy to integrate into existing processes due to their modular nature and compact size. As a result, the use of membrane-based separation processes shall become more common in the future.

In order to develop and evaluate membrane technologies for environmental separations, a research team was formed at the EPA's National Risk Management Research Laboratory (NRMRL). The general objective of the Membrane Separations Team (MST) is to investigate the use of solution-diffusion based membrane processes to perform separations of environmental importance. Solution-diffusion processes include Pervaporation (PV), Vapor Permeation (VP), Forward Osmosis (FO), and Reverse Osmosis (RO). These technologies were selected for their potential to solve environmental problems and the capability for pollution prevention applications. The target contaminants for past projects have been Volatile Organic Compounds (VOCs), many of which are carcinogens or are responsible for smog and ground level ozone formation. In addition, the MST has initiated research to use pervaporation and vapor permeation to dehydrate alcohols and other solvents for green engineering applications as well as to recover alcohols from biomass fermentation processes. Most recently, the MST has started to study evaporative membrane technologies, including pervaporation, membrane distillation (MD), and vacuum membrane distillation (VMD), for water production and salt recovery from saline streams.

The goal of our research is to reduce and manage risks by applying membrane technologies to strategic environmental separations, developing membranes which address some of the limitations of the technologies, verifying the application of the membrane technologies for actual applications, evaluating the pollution prevention capabilities of the membrane technologies, and investigating new membrane materials.

Pervaporation is a process in which a liquid stream containing volatile compounds is placed in contact with one side of a non-porous polymeric membrane while a vacuum or gas purge is applied to the other side. The components in the liquid stream sorb into the membrane, **per**meate through the membrane, and **evaporate** into the vapor phase (hence the word **pervaporate**). The vapor is then condensed. By using a membrane which is selective for one compound or a class of compounds, the material on the vapor side of the membrane shall contain those compounds with concentrations significantly higher than those on the liquid side of the membrane. A concentration factor of 1,000 is not uncommon when dissimilar compounds are to be separated. For situations where the compounds to be separated are more similar, for example isopropanol and water, separation factors are lower. Pervaporation can be used to remove water from organic solvent streams by selecting a membrane which is hydrophilic, such as poly(vinyl alcohol). In this situation, water is preferentially transported through the membrane. The liquid feed is then depleted in water, while the permeate shall be enriched in water.

Pervaporation processes have found use in the chemical industry to break azeotropic water/alcohol mixtures and to perform separations which are highly energy intensive when distillation is used. Over the past decade, a growing amount of attention has been paid to the application of pervaporation to environmental problems. In many of these instances, small amounts of a VOC must be removed from a large amount of water. Conventionally, air stripping or activated carbon treatment are used, however, air stripping is susceptible to fouling and merely turns a water pollution problem into an air pollution problem and activated carbon treatment involves costly regeneration steps and may not be suitable for VOCs which are easily displaced by other organic compounds. Several advantages of pervaporation are: no fugitive emissions, no regeneration costs (VOCs are continuously removed on vacuum side), compact/modular systems, and low operating costs. An additional advantage of pervaporation is the potential to recycle/reuse the recovered VOC.

Vapor permeation is very similar to pervaporation. The main difference is that the feed to a vapor permeation process is in the form of a vapor whereas the feed to a pervaporation process is a liquid. Otherwise, the general process configuration is the same.

Membrane distillation involves the evaporation of volatile compounds from a warm feed solution, vapor transfer through a porous membrane, and condensation in a cold permeate solution. When the permeate is a vacuum vapor stream, it is referred to as "vacuum membrane distillation".

The purpose of this work assignment is to develop new membranes and new applications of these technologies using bench and pilot scale pervaporation test units. NRMRL's Membrane

Separations Team currently operates four bench-scale pervaporation units, one bench-scale vapor permeation unit, and one pilot-scale pervaporation/vapor permeation unit. As the projects progress, changes in experimental configurations shall be necessary. As a result, modifications to the existing bench and pilot units, shall be required. Furthermore, on-going system maintenance and logistical support shall be required. Finally, for several years, the MST has been investigating the recovery of ethanol and other alcohols from fermentation broths and studying the conversion of waste biomass and sugars to ethanol by fermentation in order to better integrate the ethanol recovery stage with the fermentation ethanol production stage.

Approach

This work assignment shall be divided into five tasks. The first task is to prepare a detailed work plan for the requested work. The second task is to provide technical fabrication and maintenance service for the bench-scale membrane units. This second task shall involve the fabrication and assembly of additional components for existing units. The third task deals with support of pilot-scale membrane research activities including the fractional condensation systems. The contractor shall provide logistical and craftsman support for the third task. In the fourth task, the contractor shall carry out activities designed to develop a better understanding of the fermentation process and how it can be integrated with pervaporation and other separation processes. The fifth task is to provide analytical support for Membrane Separations Team activities. The task involves the design, fabrication, assembly, and installation of a test apparatus/analytical system for small membrane samples.

(Note: All property is subject to required approvals, and contract modification when required, per EPA property requirements. The government shall retain ownership of all equipment purchased and fabricated for this work assignment when the current T&E Facility contract expires.)

The headings below outline the details of Tasks 2-5:

Task #2 Fabrication/Modification of Bench-scale Pervaporation and Vapor Permeation Units

- The contractor shall modify and maintain the four (4) existing pervaporation bench-scale units and one (1) existing vapor permeation bench-scale unit.
  Expected modifications:
  1. Modify one bench-scale unit to accept two new membrane modules or modify two bench-scale units to each accept one new membrane module.
  2. Modify one unit to allow control of permeate pressure and to handle larger volumes of permeate condensate than currently feasible, this may involve a new condensing system or modification of an existing one
- The contractor shall obtain additional fittings, tubing, adapters, etc.
- The contractor shall identify what material and equipment is already available and what must be procured or fabricated
- The contractor shall procure/fabricate additional membrane cells according to provided specifications

- The contractor shall procure/fabricate membrane preparation devices or contract for the preparation of small membrane samples based on specifications provided by the WACOR

Task #3 Technical Assistance for Pilot Unit Activities

The contractor shall provide assistance, as needed and requested, in modifying or maintaining the pervaporation/vapor permeation pilot unit. The contractor shall be responsible for obtaining and installing equipment and supplies required for these modifications.

3.1 The contractor shall be responsible for technical support for the maintenance and modification of the pervaporation/vapor permeation pilot unit, as required and requested by the WACOR. The contractor shall anticipate repair/replacement of one major system component (such as the 30 kW heater, membrane modules, filtration system, vacuum pump, vapor compressor or chilling system) during the course of this work assignment.

3.2 The contractor shall provide technical support for the maintenance and modification of the 80-liter fermenter and integration of the fermenter with pervaporation equipment and other solvent recovery equipment. This integration shall involve connecting the fermenter with pilot or bench equipment, filtration units and a centrifuge. It is likely that this shall include interfacing the fermenter with a vacuum stripping column.

3.3 The contractor shall modify the pilot unit, as necessary, to accommodate up to four (4) new vapor permeation modules and up to two (2) new pervaporation modules. The WACOR shall provide the modules to the contractor or the contractor may be asked to obtain the modules. This installation may require rerouting vacuum/vapor lines and possibly the purchase and installation of additional vacuum generation equipment, vacuum/pressure control equipment, vapor compression equipment, heat tracing, and hoses/piping.

3.4 The contractor shall continue with modifications to a Phased Rotor Compressor and installation of the compressor with the pilot system. This compressor is non-lubricated (except for the bearing system) and includes a phasing gear. Installation of the new compressor will require a temperature control system for providing heating/cooling to a recirculated heat transfer fluid. This system shall include an inlet vapor heat exchanger, an outlet vapor heat exchanger, and lube oil temperature control as well as other components to avoid excessive operating temperatures and avoid condensation of vapors, or other configuration based on design provided by WACOR. The contractor shall evaluate heating/cooling components already available on the pervaporation pilot unit and obtain necessary additional components.

3.5 The contractor shall support the installation of a floating scroll vacuum pump (purchased under a previous work assignment) with vapor connections, temperature control, and vacuum monitoring. A larger capacity floating scroll vacuum pump/compressor shall be obtained if requested by the WACOR.

3.6 The contractor shall modify the vapor stripping/condensation system to link the vapor stripper and fractional condenser units. This shall likely require additional vacuum compression capabilities as well as vacuum/vapor lines, heat trace, sampling ports/devices, and on-line alcohol quantification devices such as refractive index, density, or near infrared meters. Schematic diagrams of the proposed process shall be provided by the WACOR.

3.7 The contractor shall provide engineering assistance for the design, operation, and optimization of the permeate fractional condensers currently installed on the pervaporation/vapor permeation pilot unit.

3.8 The contractor shall provide logistical support for integrating the condenser systems with pervaporation units provided by third parties at the T&E Facility and possibly one field location in the lower 48 states. Support for field activities shall be limited to equipment mobilization, transport, installation, demobilization, and reinstallation at T&E Facility. The contractor shall not be responsible for operating the equipment.

Task #4 Conversion of Biomass to Alcohols and Integration of Alcohol Recovery Systems with Bioreactors

4.1 Contractor shall maintain fermentation equipment in proper operating condition for fermentations.

4.2 Contractor shall operate fermentations on defined media in batch mode to provide fermentation broth which the WACOR shall use as a feed solution in membrane testing. Contractor shall coordinate a fermentation schedule with the WAM. No more than five batches of yeast fermentation broth are expected.

4.3 Contractor shall review and follow existing EPA Quality Assurance Project Plans (QAPPs) and standard operating procedures (SOPs). As necessary and after approval by EPA WACOR, contractor shall revise existing and prepare new QAPPs and SOPs. The main QAPP for this task is "Ethanol Production by Biomass Fermentation Coupled with Ethanol Recovery by Pervaporation", S-10715-QP-1-0, approved on January 18, 2005.

Task #5 Analytical Support for Membrane Separations Team Activities

The contractor shall provide analytical support for Membrane Separations Team activities at the Andrew W. Breidenbach Environmental Research Center (AWBERC) and the Test & Evaluation Facility (T&E). The Membrane Separations Team operates two gas chromatographs (GCs) at AWBERC and one GC at the T&E. This analytical support shall consist of:

1) Calibration services
2) Regular preparation and analysis of quality control check samples
3) Routine and as-needed maintenance services
4) Revision or preparation of Standard Operating Procedures (SOPs) for the equipment
5) Analysis of samples

It is anticipated that activities related to this task shall require approximately 2.0 days of support per week. The contractor shall coordinate with other on-site analytical support contractors also using the AWBERC GCs to ensure the following frequency of QA/QC activities is carried out

without overlap.

5.1. The subject analytical equipment is as follows:

5.1.1. AWBERC Room 411 – Agilent GC/Mass Spectrometer (GC/MS) with CombiPAL liquid/SPME/headspace injection autosampler.

5.1.2. AWBERC Room 411 – Agilent 6890 GC equipped with a flame ionization detector (FID) and thermal conductivity detector (TCD) with an Agilent liquid injection autosampler and gas sampling valve

5.1.3. T&E Room 109 – Agilent 6890 GC equipped with one FID and one thermal conductivity detector (TCD) (in series) and a LEAP CombiPAL liquid and headspace autosampler.

5.2. The WAM shall provide existing SOPs for each piece of equipment listed in section 5.1 to the Contractor. The WAM shall provide a summary of Quality Assurance/Quality Control (QA/QC) objectives for the analytical equipment listed in 5.1 above. The Contractor shall review existing SOPs and modify those SOPs as necessary, after approval by the WAM. The contractor shall update the SOP for the GC at the T&E Facility (see section 5.2.5). The contractor shall follow SOP preparation protocols established by the EPA Quality Assurance program (see SOP No. STD-P-01-1)
http://ciord1nd/NRMRL/Intranet/webfiles.nsf/Files/STDP11/$file/STD-P1-1.PDF

Pertinent SOPs:

5.2.1. SOP No. STD-P-01-1, TITLE: Preparation and Review of Standard Operating Procedures (SOPs)

5.2.2. SOP No. STD-P-04-1, TITLE: Method Detection Limits (MDLs) and Reporting Limits (RLs)

5.2.3. SOP No. CPB-M-02-0, TITLE: Analysis of Organic Compounds by Direct Injection Using Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique

5.2.4. SOP No. CPB-M31-0, TITLE: Volatile Organic Compounds By Gas Chromatography

5.2.5. SOP No. CPB-M33-0, TITLE: Volatile Organic Compounds By Gas Chromatography At The T&E Facility

Pertinent QAPPs - the WACOR shall provide a summary of pertinent QA/QC objectives to the contractor

5.3. The contractor shall make suggestions regarding modifications to existing methods and procedures for subject equipment, and implement modifications approved by the WACOR.

5.4. The contractor shall continue developing method(s) and calibrations for mixtures of acetone-butanol-ethanol-water on the T&E Agilent 6890 GC with TCD detector.

5.5. The contractor shall prepare and analyze a series of Quality Control (QC) samples on each piece of equipment listed in section 5.1., as follows (concentrations and specific analytes may be modified as work progresses):

5.5.1. AWBERC Room 411 GC/MS – **Once every two weeks**. Analytes: ethanol and water. Direct injection. QC concentrations: 100, 500, 1000, 5000, and 10,000 mg/L. Calibrations sufficient to cover range of 0 to 100 wt% ethanol in water.

5.5.2. AWBERC Room 411 – Agilent 6890 GC-FID. **Once every two weeks when requested by WAM**. Analytes: ethanol, n-butanol, acetone, and isopropyl alcohol in water matrix. QC samples: 100, 500, 1000, 5000, and 10,000 mg/L.

5.5.3. T&E Room 109 – Agilent 6890 GC. **Once every two weeks.**

5.5.3.1 FID. Analytes: acetone, ethanol, and n-butanol, and, if requested by WAM, ethyl acetate, and isopropyl alcohol. QC samples: 100, 500, 1000, 5000, and 10,000 mg/L.

5.5.3.2 TCD. Analytes: acetone, ethanol, n-butanol and water (binary to quaternary mixtures). Other analytes may be added as the project progresses. Calibrated in mg/L of each, either prepared without diluent or prepared in dry 1-propanol. QC samples of mixtures of all compounds and neat materials, but at least samples containing ethanol:water wt:wt ratios of 5:95, 50:50, and 95:5 and samples containing butanol:water wt:wt ratios of 5:95 and 90:10. Another QC sample shall be a 1:1:1:1 (by weight) mixture of acetone:butanol:ethanol:water.

5.6. The contractor shall prepare continuing calibration check solutions which have the same concentration as midpoint calibration standards. These solutions shall be used by the Membrane Separations Team analyst to check the validity of the calibration when analyzing samples on the equipment. A mid-point ethanol standard (such as 1,000 or 5,000 mg/L) shall be analyzed each day the FID unit is operated – once at the beginning and once at the end of each set of samples. If the TCD is to be used for ethanol determination, then a **50:50 by wt ethanol-water** standard shall be analyzed each day the TCD detector is used. If the TCD is to be used for butanol determination, then a **90:10 by wt butanol:water** standard shall be analyzed each day the TCD detector is used. For ABE-water mixtures a 25:25:25:25 wt mixture shall be analyzed as the QC. The specific analytes and concentrations shall be determined via consultation between the contractor and the WAM. The contractor is not responsible for carrying out these continuing calibration checks, unless the contractor is the analyst.

5.7. The contractor shall perform calibrations of equipment for the analytes identified above as needed based on the results of QC checks, after approval of the WACOR, or based on requests by the WACOR. Full recalibrations have typically been needed infrequently, typically yearly for the FID detectors but about every 3 months for the TCD detector.

5.8. The contractor shall communicate the results of the QC analyses and any inconsistencies or deviations from established criteria to the WAM within 24 hours. QC data shall be entered into an Excel spreadsheet and e-mailed to the WAM or, if the spreadsheet is in an accessible location, the WAM shall be notified by e-mail that the spreadsheet has been updated. WAM shall provide QC acceptance criteria to Contractor.

5.9. The contractor shall perform routine, as-needed, and preventative maintenance of equipment. Such maintenance includes, but is not limited to, replacing injector septa, replacing inlet liners, replacing autosampler syringes, and adjusting/clipping chromatographic columns. This maintenance may be self-initiated by the contractor or requested by the WACOR.

5.10. The contractor shall determine the required parts/services for connecting the FID and TCD detectors on the GC in room 411 and implement conversion if approved by WACOR. The GC is currently configured to operate the FID and TCD detectors separately, but connecting them in series (TCD, then FID) would enable measurement by both on a given sample. If the GC is converted to series TCD-FID detector, contractor shall calibrate and carry out QA/QC on the FID/TCD as described in section 5.5.3 for the T&E GC for ethanol-water mixtures.

5.11. The contractor shall follow logbook formats, data sheet formats, computerized software, and sample label formats provided by the WACOR. The contractor shall keep a record of equipment maintenance, calibration, and QC analyses.

5.12. Supplies, equipment and instrumentation shall be provided by the WACOR. The contractor shall provide requests for materials and supplies to the WACOR. Infrequently, the contractor shall provide supplies, as needed.

5.13. The WACOR shall provide initial orientation to the contractor on existing protocols, SOPs, location and storage of reagents, sample preparation, and operation of instruments and use of data analysis software.

5.14. The contractor and the WACOR shall agree on the dates and times of equipment usage by the contractor.

5.15. The contractor shall inform the WACOR of method or equipment changes made by the contractor. Likewise, the WACOR shall inform the contractor of changes in equipment or methods.

5.16. Infrequently and as requested in writing by the WACOR, the contractor shall provide an overview of analytical methods and/or procedures to the WACOR.

5.17. The contractor shall analyze samples provided by the WACOR on the subject analytical equipment. Such requests are expected to be routine with an estimated frequency of three sets of about 15 samples every week for project activities at AWBERC. In the process of developing new methods or procedures, the contractor shall need to analyze limited sets of actual experimental samples (provided by WACOR) in order to ensure proper quantification for the actual sample matrices. The contractor shall communicate the results of those analyses to the WACOR within 5 business days of receiving the samples.

The contractor shall comply with all requirements as delineated on the Quality Assurance Planning Requirements Form (see QA attachment #1).

The contractor shall maintain a file on all work documentation and shall submit the file as the Final Report.

Technical direction will be provided by the WACOR when needed in each tasks of the work assignment.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-06

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Tech support to NHSRC at T&E
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec 3 # 1,2,3, and 4

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full TItle: Technical Support to NHSRC research projects at T&E facility and field locations

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (*Max 2*) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2015		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee:	LOE:
Cumulative Approved:	Cost/Fee:	LOE:

Work Assignment Manager Name John Hall (Signature) (Date)	Branch/Mail Code: Phone Number 513-487-2814 FAX Number:
Project Officer Name Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: **0-06**

TITLE:
Technical Support to National Homeland Security Research Center (NHSRC) Research projects at Test and Evaluation Facility (T&E) and field locations

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
John Hall
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ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
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PERIOD OF PERFORMANCE:
June 1, 2014 to May 31, 2015

OBJECTIVE:
The objective of this Work Assignment shall be to provide technical support to the EPA in order to conduct controlled research and development (R&D) studies utilizing various distribution system simulators (DSS) and to test EPA developed detection and decontamination technologies and methods.

TECHNICAL SUPPORT
The contractor shall provide technical support to NHSRC projects at EPA's Test and Evaluation (T&E) research facility. These projects include testing and maintenance of various sensors and monitors under controlled conditions on the single pass distribution system simulator. The contractor shall support EPA's bench and pilot scale decontamination initiatives. The contractor shall support the testing of event detection software using a variety of sensor equipment. The contractor shall continue to support guest researchers working on NHSRC projects at the T&E facility.

This work assignment shall provide technical support to NHSRC projects at field locations as required. The contractor will support transportation of equipment and supplies to and from Ft. Riley Kansas (i.e. horse trailer) and Louisville Water Works (CANARY testing) and Dayton Water Works (5 waters response curve).

Technical Direction will be used and supplied by the WACOR when needed, unless it increases the LOE or costs on this work assignment. Then the work assignment will be amended.

Task 1: Sensor Research

The contractor shall continue to investigate various sensor and monitoring devices for water security applications. The EPA WACOR shall identify (through written technical direction) sensor and monitoring devices for investigation. If needed, the contractor shall submit a standardized report for all sensor equipment investigated (i.e. letter report, S::CAN Spectrolyser, by H. Piao) as directed by the WACOR.

The contractor shall maintain existing water quality sensors and telemetry equipment in good working condition and in a state of readiness as the primary focus of this task. The contractor shall assure that each sensor and monitoring technology being investigated is maintained according to manufacturer's calibration protocols and procedures, including the purchase and use of all necessary consumables and reagents. The contractor shall assure that all data from all the sensors and monitors on the distributions system simulator and on the test manifold are on-line, checked for errors, and accessible. Any data offered to partners or collaborators shall be quality control checked.

The sensors and monitors shall receive tap water from the 3" single pass distribution system simulators (the single pass line). The contractor shall assure that the water introduced to the sensors and monitors is representative of the water flowing through the DSS test unit. The contractor shall provide flow to the 3" single pass system such that the free chlorine residual remains constant at the 80 and 1100 foot monitoring stations.

The contractor shall also plumb cooling water used at the T&E facility to the single pass distribution system for testing with recycled waters and to conserve water usage.

The contractor shall follow quality assurance, engineering control, and health and safety protocols and procedures described in the master QAPP for this contract.

The contractor shall maintain the following core equipment on the 3" single pass line. The sensor and monitoring technologies to be utilized are a combination of conventional off-the self, innovative, promising technologies, sensor technologies, SCADA software enhancements, and micro- technologies. Some pieces of the above listed equipment may be relocated to other facilities during the contract year.

All S:CAN equipment with Monti:tool event detection software

Hach Laser Turbimeter
Hach GLI panel (free chlorine, turbidity, pH, conductivity, temperature)
Hach UVAS
Hach reagentless chlorine probe

One (1) O/I TOC sensor
2 Realtech UVT
Optiqua Refractive Index sensor
ASA Analytics On-line fluorometer

The contractor shall also keep the Intellisonde working on the decon loop.

Using technical direction, the EPA WACOR may request substitute equipment for sensor experiments that will be purchased in lieu of what is listed above.

The contractor shall continue sensor response to contamination tests on the 3" single pass 1200 foot pipeline in the high bay area when technically directed by the WACOR. Planned experiments focus on supporting other work assignments and federal agencies. Planned sensor experiments include, but are not limited to:

- Contractor shall prepare a report on the injections of sodium thiosulfate and sodium chloride for the Optiqua refractive index monitoring device and the ASA device and submit to EPA by the end of the option year
- Inject *E. coli* and *Bacillus* spores for the iBioscan device testing
- Contractor shall work with EPA and the manufacturer to improve and acquire long term O&M data for the Beta Ram unit
- Contractor shall obtain water from Dayton and predict contaminant responses from 5 waters response curves, then perform sampling to compare curve fit. The contractor shall prepare a journal paper on this work and submit to EPA. The contractor shall deliver a draft report one month before the end of the option year. EPA will provide comments within one week of delivery of the draft report. The contractor shall deliver a final report by the end of the option year.
- Contractor shall construct and test an in the waste water pipe sampling device using uv light principles of detection (iscan or similar device). This work should be done in conjunction with camera flow monitoring project.
- The contractor shall continue to develop light based sensors for contaminant warning systems.
- Contractor shall lease and test an iBioscan device along with a ZAPS LiquID device versus several biological contaminants

Based upon the results of the previous evaluations and current NHSRC priorities, the EPA WACOR may provide written technical direction to perform additional test runs on contaminants

or their surrogates. The contractor shall assist the EPA WACOR in the development of Equipment Reports for the Water ISAC or EPA internet sites.

The EPA WACOR will identify priority contaminants for testing on the single pass DSS as required. The contaminants for this option year may include but are not limited to:

Acrylonitrile
Aldicarb
4-methylcyclohexane methanol (MCHM)
Cyanide (sodium)
Fenamiphos
Fluoroacetate (sodium)
Mercuric (chloride)
Methyl parathion
Nicotine
Sodium chloride
Ecoli with and without sodium thiosulfate
Bacillus spores
Naegleria fowleri or surrogate
Sodium thiosulfate

The contractor shall ensure the single pass DSS is flushed after contaminant injection trials and that baseline water quality is not affected by the presence of contamination.

All data collected from sensors and monitors shall be sanitized and QA/QC checks performed within 24 hours of the test run. The contractor shall insure the EPA WACOR is provided an electronic copy of the QA/QC checked data. The electronic copy shall have base line, spike time, spike concentrations, results and trend lines, assumptions, observations and comments about a specific test sensor or monitor. The data shall be made available to EPA in real time on the superduo server via the Team View software. All text, tables, graphs, and data shall be provided in EPA approved format.

Task 2: Bench and Pilot Scale Decontamination Experiments

The contractor shall support pilot scale persistence and decontamination experiments using the decontamination loop with the attached Kennedy fire hydrant. *B. globigii* spores will be used as a contaminant, as will stable surrogate radionuclides (cesium, strontium, and/or cobalt) may also be examined. Contamination experiments will be performed by either using the fire hydrant to introduce contaminants into the loop or directly introducing contaminant into the pipe or through the recirculation tank. The efficacy of various decontamination methods (contaminant removal and or inactivation procedures) will be studied. This may include flushing of the pipe loop, increasing disinfectant dose (chlorine, chloramine, UV, ozone, chlorine dioxide, acidified nitrite, nitrous oxide and peracetic acid) or adding a decontaminating agent that will be determined by the WACOR through technical direction. The effects of introducing beneficial decontamination

agents such as germinants or surfactants may also be studied during this testing. If necessary, the contractor shall also support bench scale inactivation experiment with *Bacillus* spores to determine the optimal disinfectant concentration to use in the pipe loop.

The contractor shall assist EPA researchers with the design and fabrication of a representative drinking water infrastructure sample surface (i.e. coupon) within the decontamination loop. The contractor shall also provide enumeration and analytical support to determine the amount of contaminant adhered to the sample surfaces before and after decontamination. The contractor will assist the EPA WACOR in developing one report or one journal article on decontamination of contaminants adhered to water infrastructure. This report or journal article will be completed by the end of the option year.

The contractor shall support bench scale persistence and decontamination studies conducted in biofilm annual reactors (BAR). BAR persistence and decontamination studies may also be carried out in the high bay with BAR's attached to pipe loop systems. The contractor shall help operate and maintain the reactors as necessary under technical direction by the WACOR.

BARs will be conditioned in Cincinnati tap water and then exposed to a contaminant. The contractor shall support analysis of the amount of contaminant adhered to coupons in the BARs as well as in the BAR bulk water phase. Contaminants will be non-radioactive soluble salts of radionuclides of interest (cesium and strontium). Contaminants may also be chemical or biological in nature (arsenic, *Escherichia coli*, and *Bacillus* spores). Contaminant persistence shall be evaluated on cement-mortar and possible iron slides in the BAR.

The contractor shall provide expert technical support on using advanced oxidations processes (AOP) for decontamination of *Bacillus* spores from drinking water infrastructure using fenton reagent. This expert support could come in the form of recommendations about how to improve existing fenton reagent decontamination methods, literature searching, bench scale tests or conducting workshops with other technical experts on decontamination using advanced oxidations processes (AOP).

Task 3: New Equipment Purchases and/or Leases

The contractor may acquire some if not all of the following equipment and evaluate their performance. Additional sensor technologies may be evaluated for purchase by EPA and the contractor during the contract year. Letter reports for each piece of equipment tested shall be prepared in conjunction with EPA if directed by the WACOR.

- Biofilm annular reactor replacement parts
- Modified Robbins Device
- Associated equipment consumables
- iBioscan device (lease)
- ZAPS LiquID device (lease)
- SCAN iscan

- Kapta probe
- Maintenance to SCADA and computer back-up and storage, if needed

New sensors may be developed during the contract year which cannot be anticipated at the time of this PWS. Also, the potential threats to be evaluated by NHSRC can re prioritize the equipment to be purchased. Due to the high capital cost of some of the above listed equipment, it may be necessary to lease equipment from a manufacturer during the applicable test period. The contractor shall collaborate with the manufacturer to obtain consent for contaminants to be tested and decontamination methods and procedures. The WACOR will work with the contractor if this equipment needs to be substituted.

Task 4: Support to Guest Researchers

The contractor shall support the following guest researchers conducting NHSRC supported experiments with the T&E DSS's and water quality sensors:

-Contractor shall support Randy Revetta and associated post doctoral students and their biofilm experiments on Loop 6. The contractor shall provide fabrication and installation services to support this project if needed. These experiments will be concluded during this contract year.

-Contractor shall support Dr. Matthew Magnuson with radiological surrogate and fluorescence detection experiments at the T&E Facility.

-Contractor shall support Robert Janke with work in the leak detection sandbox. *E. coli*, *Bacillus* spores and an anion such as bromide will be used as contaminants.

-Contractor shall support Regan Murray and Terra Haxton with pilot scale flushing studies in the Hydrant decon loop or Loop XG. Support may include operation of the decon loops and reporting data.

-Contractor shall support interagency work in the wastewater test bed with non-chlorinated secondary effluent flowing through it. Support may include periodically adding and removing samples, cleaning and calibrating sensors and shipping samples off site.

-Contractor shall support Vicente Gallardo's work on the water sample concentrator. Support will include providing 50L carboys Ohio River or Mill Creek water when requested.

-Contractor will support Dr. Jim Goodrich and his experiments on disinfection of water using plasma shells. Support will include purchasing the plasma shells and constructing a portable water disinfection system that includes the plasma shell technology. Modifications to a Harmsco or other existing water filtration system at T&E may be required. The contractor will also support water treatment experiments where non-pathogenic microbial agents are spiked into the water treatment system and the performance of the plasma shell disinfection is assessed.

Task 5: Event Detection Algorithm Research
The contractor shall continue to compare the performance the SCAN Monti:: tool software, the Hach event detection equipment with the Guardian Blue library and the Sandia event detection algorithms with each other using data collected from T&E or field locations.. The contractor shall compare algorithm response in a report to EPA.

The contractor shall also continue to work with EPA to test alarm algorithms developed by Sandia National Labs with on line sensor full spectral UV-Vis data.

The contractor shall develop and maintain a chart or spreadsheet to continuously monitor the performance results of event detection software.

Contractor shall work with a software modeling contractor to integrate and test EPA developed CANARY software within an existing commercially available modeling product and test at the Louisville Water Works. A one day trip to Louisville by car is anticipated. The contractor shall operate the CANARY event detection with field data provided by the telemetry equipment at the off-site test loop demonstration project. The contractor shall prepare one report for the EPA Water Technology Innovation Cluster providing the results of the CANARY integration project in Louisville. The contractor shall deliver the draft report one month before the end of the option year. EPA will provide comments within one week of delivery of the draft report. The contractor shall deliver a final report by the end of the option year.

The Contractor shall work with Urbanalta and Dan Murray to develop a combined storm water monitoring and CANARY event detection application. The contractor shall also assist the development of a Hydrant tamper sensor and alarm system.

Task 6: Development of a Pilot Scale Aircraft Drinking Water System
The contractor shall support construction of a pilot scale "mock" aircraft drinking water system. The system will consist of a storage on boarding tank (donated by Boeing), flexible polymer tubing and aircraft bathroom fixtures. The mock system will also include section of tubing that can be removed an analyzed for biofilm formation or adhered contaminant. The contractor shall ensure that the tank is full of tap water on a daily basis and that demand at the fixture is indicative of demand on an airplane in flight.

The contactor shall support injection of contaminants into the mock system. Contaminants will include hydrocarbons such as gasoline or jet fuel and microbial agents such as non pathogenic E. *coli* or *Bacillus* spores. The contractor shall monitor contaminant persistence and initiate decontamination if persistence is observed. Partnering airlines will provide their Standard operating decontamination procedures. The contractor shall employ decontamination measures such as flushing or adding a decontamination agent (disinfectants, surfactants, etc.) and compare them to the existing airline decon procedures. The contractor shall also monitor water quality parameters such as disinfectant residual, pH, temperature, etc. through grab samples and with

online sensors.

Task 7: Support for Treating Large Volumes of Water
Contractor shall transport the portable AOP trailer water treatment unit from Ft. Riley Kansas to the T&E facility. Once returned to the T&E facility, the contractor shall prepare a QAPP that describes how the AOP trailer works, the operation and maintenance of the treatment unit(s) and lays out a protocol for experiments on treatment of large volumes of water using the trailer. The focus contaminants will be *Bacillus* spores and (stable) cesium chloride. The experimental treatment protocol should be flexible enough that new treatment technologies and be added to the QAPP in place of the AOP trailer.

Once the QAPP is complete and approved, the contractor shall conduct treatment experiments using the AOP trailer. The contractor shall use the results of the report titled "Literature Review of current practices for the containment, treatment and disposal of large volume of contaminated water and wastewater" as a resource for new water treatment technologies that may be tested using the approved QAPP. The contractor completed this report during work assignment 4-07 under contract EP-C-09-041.

The contractor shall provide expert technical support on using advanced oxidations processes (AOP) for treatment of drinking water or wastewater containing *Bacillus* spores or organic chemicals. This expert support could come in the form of recommendations about how to improve existing treatment methods, literature searching, bench scale tests or conducting workshops with other technical experts on decontamination using AOP.

Quality Assurance
The contractor shall maintain a compendium of all applicable T&E SOPs for submittal to NHSRC QA manager such that future work can be cross referenced to existing SOPs. The contractor shall update existing QAPPs for sensor research and decontamination experiments to reflect new equipment which has been added and to include new contaminants and experimental protocols.

The contractor shall comply with all requirements as delineated on the "Quality Assurance Planning Requirement Form (QARF)" included with this extramural action, see attachments. The contractor shall prepare a QAPP in accordance with R-2 and R-5 and/or the attachment provided with the SOW. The QAPP must be approved prior to the start of any work. Additional information related to QA requirements can be found at: http://www.epa.gov/quality/qs-docs/r5-final.pdf

The contractor shall update existing project HASPs to include new contaminants. Any substantive changes to the specifications in the approved work plan shall be documented by the contractor as a revision to the HASP.

Reporting

The contractor shall provide a work plan that sets the contractor's approach, staffing, schedule, milestones, and estimated budget for the completion of the tasks under this work assignment. Monthly reports summarizing the status of this Work Assignment shall be completed and provided to the EPA CL-COR as part of the Work Assignment deliverables. The monthly reports shall;

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks,
- Summarize the planned activities anticipated for the upcoming period,
- Identify problems and resolutions encountered,
- Shall be used to evaluate the status and the progress of the work,
- Shall be used to resolve technical and/or budgeting problems, and
- Identify and demonstrate expenditures

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-06

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015 Base X Option Period Number	Technical Support to NHSRC Res

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec. 3, #1, 2, 3 and 4

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full title: Technical Support to NHSRC Research projects at T&E facility and field locations. This amendment is de-scoping some tasks under Task #1, Sensor Research. The original WP was 30% more than what EPA estimated. The IGCE was not accurate to what was asked in the WA. It was decided to de-scope some of the task under Task 1 to align with what was realistic of costs.

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 06/01/2014 To 05/31/2015		5,455
This Action:		0
Total:		5,455

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: John Hall (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2814 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-06

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Technical Support to NHSRC Res
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec. 3, #1, 2, 3 and 4

Purpose:
- ☐ Work Assignment
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This Action:		0
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Work Plan / Cost Estimate Approvals

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Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: John Hall	Branch/Mail Code:
(Signature) (Date)	Phone Number: 513-487-2814
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Contracting Official Name: Mark Cranley	Branch/Mail Code:
(Signature) (Date)	Phone Number: 513-487-2351
	FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: **0-06**
Amendment 1

This amendment is de-scoping some tasks under Task #1, Sensor Research.

TITLE:
Technical Support to National Homeland Security Research Center (NHSRC) Research projects at Test and Evaluation Facility (T&E) and field locations

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
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Cyanide (sodium)
Fenamiphos
Fluoroacetate (sodium)
Mercuric (chloride)
Methyl parathion
Nicotine
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Ecoli with and without sodium thiosulfate
Bacillus spores
Naegleria fowleri or surrogate
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The contractor shall provide expert technical support on using advanced oxidations processes (AOP) for decontamination of *Bacillus* spores from drinking water infrastructure using fenton reagent. This expert support could come in the form of recommendations about how to improve existing fenton reagent decontamination methods, literature searching, bench scale tests or conducting workshops with other technical experts on decontamination using advanced oxidations processes (AOP).

Task 3: New Equipment Purchases and/or Leases

The contractor may acquire some if not all of the following equipment and evaluate their performance. Additional sensor technologies may be evaluated for purchase by EPA and the contractor during the contract year. Letter reports for each piece of equipment tested shall be prepared in conjunction with EPA if directed by the WACOR.

- Biofilm annular reactor replacement parts
- Modified Robbins Device
- Associated equipment consumables

- iBioscan device (lease)
- ZAPS LiquID device (lease)
- SCAN iscan
- Kapta probe
- Maintenance to SCADA and computer back-up and storage, if needed

New sensors may be developed during the contract year which cannot be anticipated at the time of this PWS. Also, the potential threats to be evaluated by NHSRC can re prioritize the equipment to be purchased. Due to the high capital cost of some of the above listed equipment, it may be necessary to lease equipment from a manufacturer during the applicable test period. The contractor shall collaborate with the manufacturer to obtain consent for contaminants to be tested and decontamination methods and procedures. The WACOR will work with the contractor if this equipment needs to be substituted.

Task 4: Support to Guest Researchers

The contractor shall support the following guest researchers conducting NHSRC supported experiments with the T&E DSS's and water quality sensors:

-Contractor shall support Randy Revetta and associated post doctoral students and their biofilm experiments on Loop 6. The contractor shall provide fabrication and installation services to support this project if needed. These experiments will be concluded during this contract year.

-Contractor shall support Dr. Matthew Magnuson with radiological surrogate and fluorescence detection experiments at the T&E Facility.

-Contractor shall support Robert Janke with work in the leak detection sandbox. *E. coli*, *Bacillus* spores and an anion such as bromide will be used as contaminants.

-Contractor shall support Regan Murray and Terra Haxton with pilot scale flushing studies in the Hydrant decon loop or Loop XG. Support may include operation of the decon loops and reporting data.

-Contractor shall support interagency work in the wastewater test bed with non-chlorinated secondary effluent flowing through it. Support may include periodically adding and removing samples, cleaning and calibrating sensors and shipping samples off site.

-Contractor shall support Vicente Gallardo's work on the water sample concentrator. Support will include providing 50L carboys Ohio River or Mill Creek water when requested.

-Contractor will support Dr. Jim Goodrich and his experiments on disinfection of water using plasma shells. Support will include purchasing the plasma shells and constructing a portable water disinfection system that includes the plasma shell technology. Modifications to a Harmsco

or other existing water filtration system at T&E may be required. The contractor will also support water treatment experiments where non-pathogenic microbial agents are spiked into the water treatment system and the performance of the plasma shell disinfection is assessed.

Task 5: Event Detection Algorithm Research

The contractor shall continue to compare the performance the SCAN Monti:: tool software, the Hach event detection equipment with the Guardian Blue library and the Sandia event detection algorithms with each other using data collected from T&E or field locations.. The contractor shall compare algorithm response in a report to EPA.

The contractor shall also continue to work with EPA to test alarm algorithms developed by Sandia National Labs with on line sensor full spectral UV-Vis data.

The contractor shall develop and maintain a chart or spreadsheet to continuously monitor the performance results of event detection software.

Contractor shall work with a software modeling contractor to integrate and test EPA developed CANARY software within an existing commercially available modeling product and test at the Louisville Water Works. A one day trip to Louisville by car is anticipated. The contractor shall operate the CANARY event detection with field data provided by the telemetry equipment at the off-site test loop demonstration project. The contractor shall prepare one report for the EPA Water Technology Innovation Cluster providing the results of the CANARY integration project in Louisville. The contractor shall deliver the draft report one month before the end of the option year. EPA will provide comments within one week of delivery of the draft report. The contractor shall deliver a final report by the end of the option year.

The Contractor shall work with Urbanalta and Dan Murray to develop a combined storm water monitoring and CANARY event detection application. The contractor shall also assist the development of a Hydrant tamper sensor and alarm system.

Task 6: Development of a Pilot Scale Aircraft Drinking Water System

The contractor shall support construction of a pilot scale "mock" aircraft drinking water system. The system will consist of a storage on boarding tank (donated by Boeing), flexible polymer tubing and aircraft bathroom fixtures. The mock system will also include section of tubing that can be removed an analyzed for biofilm formation or adhered contaminant. The contractor shall ensure that the tank is full of tap water on a daily basis and that demand at the fixture is indicative of demand on an airplane in flight.

The contactor shall support injection of contaminants into the mock system. Contaminants will include hydrocarbons such as gasoline or jet fuel and microbial agents such as non pathogenic E. *coli* or *Bacillus* spores. The contractor shall monitor contaminant persistence and initiate decontamination if persistence is observed. Partnering airlines will provide their Standard operating decontamination procedures. The contractor shall employ decontamination measures

such as flushing or adding a decontamination agent (disinfectants, surfactants, etc.) and compare them to the existing airline decon procedures. The contractor shall also monitor water quality parameters such as disinfectant residual, pH, temperature, etc. through grab samples and with online sensors.

Task 7: Support for Treating Large Volumes of Water

Contractor shall transport the portable AOP trailer water treatment unit from Ft. Riley Kansas to the T&E facility. Once returned to the T&E facility, the contractor shall prepare a QAPP that describes how the AOP trailer works, the operation and maintenance of the treatment unit(s) and lays out a protocol for experiments on treatment of large volumes of water using the trailer. The focus contaminants will be *Bacillus* spores and (stable) cesium chloride. The experimental treatment protocol should be flexible enough that new treatment technologies and be added to the QAPP in place of the AOP trailer.

Once the QAPP is complete and approved, the contractor shall conduct treatment experiments using the AOP trailer. The contractor shall use the results of the report titled "Literature Review of current practices for the containment, treatment and disposal of large volume of contaminated water and wastewater" as a resource for new water treatment technologies that may be tested using the approved QAPP. The contractor completed this report during work assignment 4-07 under contract EP-C-09-041.

The contractor shall provide expert technical support on using advanced oxidations processes (AOP) for treatment of drinking water or wastewater containing *Bacillus* spores or organic chemicals. This expert support could come in the form of recommendations about how to improve existing treatment methods, literature searching, bench scale tests or conducting workshops with other technical experts on decontamination using AOP.

Quality Assurance

The contractor shall maintain a compendium of all applicable T&E SOPs for submittal to NHSRC QA manager such that future work can be cross referenced to existing SOPs. The contractor shall update existing QAPPs for sensor research and decontamination experiments to reflect new equipment which has been added and to include new contaminants and experimental protocols.

The contractor shall comply with all requirements as delineated on the "Quality Assurance Planning Requirement Form (QARF)" included with this extramural action, see attachments. The contractor shall prepare a QAPP in accordance with R-2 and R-5 and/or the attachment provided with the SOW. The QAPP must be approved prior to the start of any work. Additional information related to QA requirements can be found at: http://www.epa.gov/quality/qs-docs/r5-final.pdf

The contractor shall update existing project HASPs to include new contaminants. Any substantive changes to the specifications in the approved work plan shall be documented by the

contractor as a revision to the HASP.

Reporting

The contractor shall provide a work plan that sets the contractor's approach, staffing, schedule, milestones, and estimated budget for the completion of the tasks under this work assignment. Monthly reports summarizing the status of this Work Assignment shall be completed and provided to the EPA CL-COR as part of the Work Assignment deliverables. The monthly reports shall;

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks,
- Summarize the planned activities anticipated for the upcoming period,
- Identify problems and resolutions encountered,
- Shall be used to evaluate the status and the progress of the work,
- Shall be used to resolve technical and/or budgeting problems, and
- Identify and demonstrate expenditures

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: **0-06**
Amendment 1

This amendment is de-scoping some tasks under Task #1, Sensor Research.

TITLE:
Technical Support to National Homeland Security Research Center (NHSRC) Research projects at Test and Evaluation Facility (T&E) and field locations

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
John Hall
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ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Jeff Szabo
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National Homeland Security Research Center
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PERIOD OF PERFORMANCE:
June 1, 2014 to May 31, 2015

OBJECTIVE:
The objective of this Work Assignment shall be to provide technical support to the EPA in order to conduct controlled research and development (R&D) studies utilizing various distribution system simulators (DSS) and to test EPA developed detection and decontamination technologies and methods.

TECHNICAL SUPPORT
The contractor shall provide technical support to NHSRC projects at EPA's Test and Evaluation (T&E) research facility. These projects include testing and maintenance of various sensors and monitors under controlled conditions on the single pass distribution system simulator. The contractor shall support EPA's bench and pilot scale decontamination initiatives. The contractor shall support the testing of event detection software using a variety of sensor equipment. The

contractor shall continue to support guest researchers working on NHSRC projects at the T&E facility.

This work assignment shall provide technical support to NHSRC projects at field locations as required. The contractor will support transportation of equipment and supplies to and from Ft. Riley Kansas (i.e. horse trailer) and Louisville Water Works (CANARY testing) and Dayton Water Works (5 waters response curve).

Technical Direction will be used and supplied by the WACOR when needed, unless it increases the LOE or costs on this work assignment. Then the work assignment will be amended.

Task 1: Sensor Research

The contractor shall continue to investigate various sensor and monitoring devices for water security applications. The EPA WACOR shall identify (through written technical direction) sensor and monitoring devices for investigation. If needed, the contractor shall submit a standardized report for all sensor equipment investigated (i.e. letter report, S::CAN Spectrolyser, by H. Piao) as directed by the WACOR.

The contractor shall maintain existing water quality sensors and telemetry equipment in good working condition and in a state of readiness as the primary focus of this task. The contractor shall assure that each sensor and monitoring technology being investigated is maintained according to manufacturer's calibration protocols and procedures, including the purchase and use of all necessary consumables and reagents. The contractor shall assure that all data from all the sensors and monitors on the distributions system simulator and on the test manifold are on-line, checked for errors, and accessible. Any data offered to partners or collaborators shall be quality control checked.

The sensors and monitors shall receive tap water from the 3" single pass distribution system simulators (the single pass line). The contractor shall assure that the water introduced to the sensors and monitors is representative of the water flowing through the DSS test unit. The contractor shall provide flow to the 3" single pass system such that the free chlorine residual remains constant at the 80 and 1100 foot monitoring stations.

The contractor shall also plumb cooling water used at the T&E facility to the single pass distribution system for testing with recycled waters and to conserve water usage.

The contractor shall follow quality assurance, engineering control, and health and safety protocols and procedures described in the master QAPP for this contract.

The contractor shall maintain the following core equipment on the 3" single pass line. The sensor and monitoring technologies to be utilized are a combination of conventional off-the self, innovative, promising technologies, sensor technologies, SCADA software enhancements, and micro- technologies. Some pieces of the above listed equipment may be relocated to other

facilities during the contract year.

All S:CAN equipment with Monti:tool event detection software
Hach Laser Turbimeter
Hach GLI panel (free chlorine, turbidity, pH, conductivity, temperature)
Hach UVAS
Hach reagentless chlorine probe

One (1) O/I TOC sensor
2 Realtech UVT
Optiqua Refractive Index sensor
ASA Analytics On-line fluorometer

The contractor shall also keep the Intellisonde working on the decon loop.

Using technical direction, the EPA WACOR may request substitute equipment for sensor experiments that will be purchased in lieu of what is listed above.

The contractor shall continue sensor response to contamination tests on the 3" single pass 1200 foot pipeline in the high bay area when technically directed by the WACOR. Planned experiments focus on supporting other work assignments and federal agencies. Planned sensor experiments include, but are not limited to:

- Contractor shall prepare a report on the injections of sodium thiosulfate and sodium chloride for the Optiqua refractive index monitoring device and the ASA device and submit to EPA by the end of the option year
- ~~Inject *E. coli* and *Bacillus* spores for the iBioscan device testing~~
- Contractor shall work with EPA and the manufacturer to improve and acquire long term O&M data for the Beta Ram unit
- Contractor shall obtain water from Dayton and predict contaminant responses from 5 waters response curves, then perform sampling to compare curve fit. ~~The contractor shall prepare a journal paper on this work and submit to EPA. The contractor shall deliver a draft report one month before the end of the option year. EPA will provide comments within one week of delivery of the draft report. The contractor shall deliver a final report by the end of the option year.~~
- Contractor shall construct and test an in the waste water pipe sampling device using uv light principles of detection (iscan or similar device). This work should be done in conjunction with camera flow monitoring project.
- The contractor shall continue to develop light based sensors for contaminant warning systems.
- ~~Contractor shall lease and test an iBioscan device along with a ZAPS LiquID device versus several biological contaminants~~

Based upon the results of the previous evaluations and current NHSRC priorities, the EPA WACOR may provide written technical direction to perform additional test runs on contaminants or their surrogates. The contractor shall assist the EPA WACOR in the development of Equipment Reports for the Water ISAC or EPA internet sites.

The EPA WACOR will identify priority contaminants for testing on the single pass DSS as required. The contaminants for this option year may include but are not limited to:

Acrylonitrile
Aldicarb
4-methylcyclohexane methanol (MCHM)
Cyanide (sodium)
Fenamiphos
Fluoroacetate (sodium)
Mercuric (chloride)
Methyl parathion
Nicotine
Sodium chloride
Ecoli with and without sodium thiosulfate
Bacillus spores
Naegleria fowleri or surrogate
Sodium thiosulfate

The contractor shall ensure the single pass DSS is flushed after contaminant injection trials and that baseline water quality is not affected by the presence of contamination.

All data collected from sensors and monitors shall be sanitized and QA/QC checks performed within 24 hours of the test run. The contractor shall insure the EPA WACOR is provided an electronic copy of the QA/QC checked data. The electronic copy shall have base line, spike time, spike concentrations, results and trend lines, assumptions, observations and comments about a specific test sensor or monitor. The data shall be made available to EPA in real time on the superduo server via the Team View software. All text, tables, graphs, and data shall be provided in EPA approved format.

Task 2: Bench and Pilot Scale Decontamination Experiments

The contractor shall support pilot scale persistence and decontamination experiments using the decontamination loop with the attached Kennedy fire hydrant. *B. globigii* spores will be used as a contaminant, as will stable surrogate radionuclides (cesium, strontium, and/or cobalt) may also be examined. Contamination experiments will be performed by either using the fire hydrant to introduce contaminants into the loop or directly introducing contaminant into the pipe or through the recirculation tank. The efficacy of various decontamination methods (contaminant removal and or inactivation procedures) will be studied. This may include flushing of the pipe loop,

increasing disinfectant dose (chlorine, chloramine, UV, ozone, chlorine dioxide, acidified nitrite, nitrous oxide and peracetic acid) or adding a decontaminating agent that will be determined by the WACOR through technical direction. The effects of introducing beneficial decontamination agents such as germinants or surfactants may also be studied during this testing. If necessary, the contractor shall also support bench scale inactivation experiment with *Bacillus* spores to determine the optimal disinfectant concentration to use in the pipe loop.

The contractor shall assist EPA researchers with the design and fabrication of a representative drinking water infrastructure sample surface (i.e. coupon) within the decontamination loop. The contractor shall also provide enumeration and analytical support to determine the amount of contaminant adhered to the sample surfaces before and after decontamination. The contractor will assist the EPA WACOR in developing one report or one journal article on decontamination of contaminants adhered to water infrastructure. This report or journal article will be completed by the end of the option year.

The contractor shall support bench scale persistence and decontamination studies conducted in biofilm annual reactors (BAR). BAR persistence and decontamination studies may also be carried out in the high bay with BAR's attached to pipe loop systems. The contractor shall help operate and maintain the reactors as necessary under technical direction by the WACOR.

BARs will be conditioned in Cincinnati tap water and then exposed to a contaminant. The contractor shall support analysis of the amount of contaminant adhered to coupons in the BARs as well as in the BAR bulk water phase. Contaminants will be non-radioactive soluble salts of radionuclides of interest (cesium and strontium). Contaminants may also be chemical or biological in nature (arsenic, *Escherichia coli*, and *Bacillus* spores). Contaminant persistence shall be evaluated on cement-mortar and possible iron slides in the BAR.

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Task 3: New Equipment Purchases and/or Leases

The contractor may acquire some if not all of the following equipment and evaluate their performance. Additional sensor technologies may be evaluated for purchase by EPA and the contractor during the contract year. Letter reports for each piece of equipment tested shall be prepared in conjunction with EPA if directed by the WACOR.

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- Associated equipment consumables

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The contractor shall support the following guest researchers conducting NHSRC supported experiments with the T&E DSS's and water quality sensors:

-Contractor shall support Randy Revetta and associated post doctoral students and their biofilm experiments on Loop 6. The contractor shall provide fabrication and installation services to support this project if needed. These experiments will be concluded during this contract year.

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or other existing water filtration system at T&E may be required. The contractor will also support water treatment experiments where non-pathogenic microbial agents are spiked into the water treatment system and the performance of the plasma shell disinfection is assessed.

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The contractor shall also continue to work with EPA to test alarm algorithms developed by Sandia National Labs with on line sensor full spectral UV-Vis data.

The contractor shall develop and maintain a chart or spreadsheet to continuously monitor the performance results of event detection software.

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The Contractor shall work with Urbanalta and Dan Murray to develop a combined storm water monitoring and CANARY event detection application. The contractor shall also assist the development of a Hydrant tamper sensor and alarm system.

Task 6: Development of a Pilot Scale Aircraft Drinking Water System

The contractor shall support construction of a pilot scale "mock" aircraft drinking water system. The system will consist of a storage on boarding tank (donated by Boeing), flexible polymer tubing and aircraft bathroom fixtures. The mock system will also include section of tubing that can be removed an analyzed for biofilm formation or adhered contaminant. The contractor shall ensure that the tank is full of tap water on a daily basis and that demand at the fixture is indicative of demand on an airplane in flight.

The contactor shall support injection of contaminants into the mock system. Contaminants will include hydrocarbons such as gasoline or jet fuel and microbial agents such as non pathogenic E. *coli* or *Bacillus* spores. The contractor shall monitor contaminant persistence and initiate decontamination if persistence is observed. Partnering airlines will provide their Standard operating decontamination procedures. The contractor shall employ decontamination measures

such as flushing or adding a decontamination agent (disinfectants, surfactants, etc.) and compare them to the existing airline decon procedures. The contractor shall also monitor water quality parameters such as disinfectant residual, pH, temperature, etc. through grab samples and with online sensors.

Task 7: Support for Treating Large Volumes of Water

Contractor shall transport the portable AOP trailer water treatment unit from Ft. Riley Kansas to the T&E facility. Once returned to the T&E facility, the contractor shall prepare a QAPP that describes how the AOP trailer works, the operation and maintenance of the treatment unit(s) and lays out a protocol for experiments on treatment of large volumes of water using the trailer. The focus contaminants will be *Bacillus* spores and (stable) cesium chloride. The experimental treatment protocol should be flexible enough that new treatment technologies and be added to the QAPP in place of the AOP trailer.

Once the QAPP is complete and approved, the contractor shall conduct treatment experiments using the AOP trailer. The contractor shall use the results of the report titled "Literature Review of current practices for the containment, treatment and disposal of large volume of contaminated water and wastewater" as a resource for new water treatment technologies that may be tested using the approved QAPP. The contractor completed this report during work assignment 4-07 under contract EP-C-09-041.

The contractor shall provide expert technical support on using advanced oxidations processes (AOP) for treatment of drinking water or wastewater containing *Bacillus* spores or organic chemicals. This expert support could come in the form of recommendations about how to improve existing treatment methods, literature searching, bench scale tests or conducting workshops with other technical experts on decontamination using AOP.

Quality Assurance

The contractor shall maintain a compendium of all applicable T&E SOPs for submittal to NHSRC QA manager such that future work can be cross referenced to existing SOPs. The contractor shall update existing QAPPs for sensor research and decontamination experiments to reflect new equipment which has been added and to include new contaminants and experimental protocols.

The contractor shall comply with all requirements as delineated on the "Quality Assurance Planning Requirement Form (QARF)" included with this extramural action, see attachments. The contractor shall prepare a QAPP in accordance with R-2 and R-5 and/or the attachment provided with the SOW. The QAPP must be approved prior to the start of any work. Additional information related to QA requirements can be found at: http://www.epa.gov/quality/qs-docs/r5-final.pdf

The contractor shall update existing project HASPs to include new contaminants. Any substantive changes to the specifications in the approved work plan shall be documented by the

contractor as a revision to the HASP.

Reporting

The contractor shall provide a work plan that sets the contractor's approach, staffing, schedule, milestones, and estimated budget for the completion of the tasks under this work assignment. Monthly reports summarizing the status of this Work Assignment shall be completed and provided to the EPA CL-COR as part of the Work Assignment deliverables. The monthly reports shall;

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks,
- Summarize the planned activities anticipated for the upcoming period,
- Identify problems and resolutions encountered,
- Shall be used to evaluate the status and the progress of the work,
- Shall be used to resolve technical and/or budgeting problems, and
- Identify and demonstrate expenditures

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-06

☐ Other ☒ Amendment Number: 000002

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015 Base X Option Period Number	Tech support NHSRC Res Project

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec 3, #1, 2, 3, and 4

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full Title: Tech Support NHSRC Res Projects T&E & Field Sites. The purpose of this amendment is to add Task 8.

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 06/01/2014 To 05/31/2015		0
This Action:		7,200
Total:		7,200

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: John Hall (Signature) (Date)		Branch/Mail Code: Phone Number: 513-487-2814 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)		Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)		Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)		Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: **0-06**
Amendment 2

This amendment is adding Task 8.

TITLE:
Technical Support to National Homeland Security Research Center (NHSRC) Research projects at Test and Evaluation Facility (T&E) and field locations

EAS Title: Tech Support NHSRC Res Projects T&E & Field Sites

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
John Hall
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ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Jeff Szabo
U.S. Environmental Protection Agency
National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-487-2823
email: szabo.jeff@epa.gov

PERIOD OF PERFORMANCE:
June 1, 2014 to May 31, 2015

OBJECTIVE:
The objective of this Work Assignment shall be to provide technical support to the EPA in order to conduct controlled research and development (R&D) studies utilizing various distribution system simulators (DSS) and to test EPA developed detection and decontamination technologies and methods.

TECHNICAL SUPPORT
The contractor shall provide technical support to NHSRC projects at EPA's Test and Evaluation (T&E) research facility. These projects include testing and maintenance of various sensors and monitors under controlled conditions on the single pass distribution system simulator. The

contractor shall support EPA's bench and pilot scale decontamination initiatives. The contractor shall support the testing of event detection software using a variety of sensor equipment. The contractor shall continue to support guest researchers working on NHSRC projects at the T&E facility.

This work assignment shall provide technical support to NHSRC projects at field locations as required. The contractor will support transportation of equipment and supplies to and from Ft. Riley Kansas (i.e. horse trailer) and Louisville Water Works (CANARY testing) and Dayton Water Works (5 waters response curve).

Technical Direction will be used and supplied by the WACOR when needed, unless it increases the LOE or costs on this work assignment. Then the work assignment will be amended.

Task 1: Sensor Research

The contractor shall continue to investigate various sensor and monitoring devices for water security applications. The EPA WACOR shall identify (through written technical direction) sensor and monitoring devices for investigation. If needed, the contractor shall submit a standardized report for all sensor equipment investigated (i.e. letter report, S::CAN Spectrolyser, by H. Piao) as directed by the WACOR.

The contractor shall maintain existing water quality sensors and telemetry equipment in good working condition and in a state of readiness as the primary focus of this task. The contractor shall assure that each sensor and monitoring technology being investigated is maintained according to manufacturer's calibration protocols and procedures, including the purchase and use of all necessary consumables and reagents. The contractor shall assure that all data from all the sensors and monitors on the distributions system simulator and on the test manifold are on-line, checked for errors, and accessible. Any data offered to partners or collaborators shall be quality control checked.

The sensors and monitors shall receive tap water from the 3" single pass distribution system simulators (the single pass line). The contractor shall assure that the water introduced to the sensors and monitors is representative of the water flowing through the DSS test unit. The contractor shall provide flow to the 3" single pass system such that the free chlorine residual remains constant at the 80 and 1100 foot monitoring stations.

The contractor shall also plumb cooling water used at the T&E facility to the single pass distribution system for testing with recycled waters and to conserve water usage.

The contractor shall follow quality assurance, engineering control, and health and safety protocols and procedures described in the master QAPP for this contract.

The contractor shall maintain the following core equipment on the 3" single pass line. The sensor and monitoring technologies to be utilized are a combination of conventional off-the self,

innovative, promising technologies, sensor technologies, SCADA software enhancements, and micro- technologies. Some pieces of the above listed equipment may be relocated to other facilities during the contract year.

All S:CAN equipment with Monti:tool event detection software
Hach Laser Turbimeter
Hach GLI panel (free chlorine, turbidity, pH, conductivity, temperature)
Hach UVAS
Hach reagentless chlorine probe

One (1) O/I TOC sensor
2 Realtech UVT
Optiqua Refractive Index sensor
ASA Analytics On-line fluorometer

The contractor shall also keep the Intellisonde working on the decon loop.

Using technical direction, the EPA WACOR may request substitute equipment for sensor experiments that will be purchased in lieu of what is listed above.

The contractor shall continue sensor response to contamination tests on the 3" single pass 1200 foot pipeline in the high bay area when technically directed by the WACOR. Planned experiments focus on supporting other work assignments and federal agencies. Planned sensor experiments include, but are not limited to:

- Contractor shall prepare a report on the injections of sodium thiosulfate and sodium chloride for the Optiqua refractive index monitoring device and the ASA device and submit to EPA by the end of the option year
-
- Contractor shall work with EPA and the manufacturer to improve and acquire long term O&M data for the Beta Ram unit
- Contractor shall obtain water from Dayton and predict contaminant responses from 5 waters response curves, then perform sampling to compare curve fit.
- Contractor shall construct and test an in the waste water pipe sampling device using uv light principles of detection (iscan or similar device). This work should be done in conjunction with camera flow monitoring project.
- The contractor shall continue to develop light based sensors for contaminant warning systems.
-

Based upon the results of the previous evaluations and current NHSRC priorities, the EPA WACOR may provide written technical direction to perform additional test runs on contaminants

or their surrogates. The contractor shall assist the EPA WACOR in the development of Equipment Reports for the Water ISAC or EPA internet sites.

The EPA WACOR will identify priority contaminants for testing on the single pass DSS as required. The contaminants for this option year may include but are not limited to:

Acrylonitrile
Aldicarb
4-methylcyclohexane methanol (MCHM)
Cyanide (sodium)
Fenamiphos
Fluoroacetate (sodium)
Mercuric (chloride)
Methyl parathion
Nicotine
Sodium chloride
Ecoli with and without sodium thiosulfate
Bacillus spores
Naegleria fowleri or surrogate
Sodium thiosulfate

The contractor shall ensure the single pass DSS is flushed after contaminant injection trials and that baseline water quality is not affected by the presence of contamination.

All data collected from sensors and monitors shall be sanitized and QA/QC checks performed within 24 hours of the test run. The contractor shall insure the EPA WACOR is provided an electronic copy of the QA/QC checked data. The electronic copy shall have base line, spike time, spike concentrations, results and trend lines, assumptions, observations and comments about a specific test sensor or monitor. The data shall be made available to EPA in real time on the superduo server via the Team View software. All text, tables, graphs, and data shall be provided in EPA approved format.

Task 2: Bench and Pilot Scale Decontamination Experiments

The contractor shall support pilot scale persistence and decontamination experiments using the decontamination loop with the attached Kennedy fire hydrant. *B. globigii* spores will be used as a contaminant, as will stable surrogate radionuclides (cesium, strontium, and/or cobalt) may also be examined. Contamination experiments will be performed by either using the fire hydrant to introduce contaminants into the loop or directly introducing contaminant into the pipe or through the recirculation tank. The efficacy of various decontamination methods (contaminant removal and or inactivation procedures) will be studied. This may include flushing of the pipe loop, increasing disinfectant dose (chlorine, chloramine, UV, ozone, chlorine dioxide, acidified nitrite, nitrous oxide and peracetic acid) or adding a decontaminating agent that will be determined by the WACOR through technical direction. The effects of introducing beneficial decontamination

agents such as germinants or surfactants may also be studied during this testing. If necessary, the contractor shall also support bench scale inactivation experiment with *Bacillus* spores to determine the optimal disinfectant concentration to use in the pipe loop.

The contractor shall assist EPA researchers with the design and fabrication of a representative drinking water infrastructure sample surface (i.e. coupon) within the decontamination loop. The contractor shall also provide enumeration and analytical support to determine the amount of contaminant adhered to the sample surfaces before and after decontamination. The contractor will assist the EPA WACOR in developing one report or one journal article on decontamination of contaminants adhered to water infrastructure. This report or journal article will be completed by the end of the option year.

The contractor shall support bench scale persistence and decontamination studies conducted in biofilm annual reactors (BAR). BAR persistence and decontamination studies may also be carried out in the high bay with BAR's attached to pipe loop systems. The contractor shall help operate and maintain the reactors as necessary under technical direction by the WACOR.

BARs will be conditioned in Cincinnati tap water and then exposed to a contaminant. The contractor shall support analysis of the amount of contaminant adhered to coupons in the BARs as well as in the BAR bulk water phase. Contaminants will be non-radioactive soluble salts of radionuclides of interest (cesium and strontium). Contaminants may also be chemical or biological in nature (arsenic, *Escherichia coli*, and *Bacillus* spores). Contaminant persistence shall be evaluated on cement-mortar and possible iron slides in the BAR.

The contractor shall provide expert technical support on using advanced oxidations processes (AOP) for decontamination of *Bacillus* spores from drinking water infrastructure using fenton reagent. This expert support could come in the form of recommendations about how to improve existing fenton reagent decontamination methods, literature searching, bench scale tests or conducting workshops with other technical experts on decontamination using advanced oxidations processes (AOP).

Task 3: New Equipment Purchases and/or Leases

The contractor may acquire some if not all of the following equipment and evaluate their performance. Additional sensor technologies may be evaluated for purchase by EPA and the contractor during the contract year. Letter reports for each piece of equipment tested shall be prepared in conjunction with EPA if directed by the WACOR.

- Biofilm annular reactor replacement parts
- Modified Robbins Device
- Associated equipment consumables
- iBioscan device (lease)
- ZAPS LiquID device (lease)
- SCAN iscan

- Kapta probe
- Maintenance to SCADA and computer back-up and storage, if needed

New sensors may be developed during the contract year which cannot be anticipated at the time of this PWS. Also, the potential threats to be evaluated by NHSRC can re prioritize the equipment to be purchased. Due to the high capital cost of some of the above listed equipment, it may be necessary to lease equipment from a manufacturer during the applicable test period. The contractor shall collaborate with the manufacturer to obtain consent for contaminants to be tested and decontamination methods and procedures. The WACOR will work with the contractor if this equipment needs to be substituted.

Task 4: Support to Guest Researchers

The contractor shall support the following guest researchers conducting NHSRC supported experiments with the T&E DSS's and water quality sensors:

-Contractor shall support Randy Revetta and associated post doctoral students and their biofilm experiments on Loop 6. The contractor shall provide fabrication and installation services to support this project if needed. These experiments will be concluded during this contract year.

-Contractor shall support Dr. Matthew Magnuson with radiological surrogate and fluorescence detection experiments at the T&E Facility.

-Contractor shall support Robert Janke with work in the leak detection sandbox. *E. coli*, *Bacillus* spores and an anion such as bromide will be used as contaminants.

-Contractor shall support Regan Murray and Terra Haxton with pilot scale flushing studies in the Hydrant decon loop or Loop XG. Support may include operation of the decon loops and reporting data.

-Contractor shall support interagency work in the wastewater test bed with non-chlorinated secondary effluent flowing through it. Support may include periodically adding and removing samples, cleaning and calibrating sensors and shipping samples off site.

-Contractor shall support Vicente Gallardo's work on the water sample concentrator. Support will include providing 50L carboys Ohio River or Mill Creek water when requested.

-Contractor will support Dr. Jim Goodrich and his experiments on disinfection of water using plasma shells. Support will include purchasing the plasma shells and constructing a portable water disinfection system that includes the plasma shell technology. Modifications to a Harmsco or other existing water filtration system at T&E may be required. The contractor will also support water treatment experiments where non-pathogenic microbial agents are spiked into the water treatment system and the performance of the plasma shell disinfection is assessed.

Task 5: Event Detection Algorithm Research
The contractor shall continue to compare the performance the SCAN Monti:: tool software, the Hach event detection equipment with the Guardian Blue library and the Sandia event detection algorithms with each other using data collected from T&E or field locations.. The contractor shall compare algorithm response in a report to EPA.

The contractor shall also continue to work with EPA to test alarm algorithms developed by Sandia National Labs with on line sensor full spectral UV-Vis data.

The contractor shall develop and maintain a chart or spreadsheet to continuously monitor the performance results of event detection software.

Contractor shall work with a software modeling contractor to integrate and test EPA developed CANARY software within an existing commercially available modeling product and test at the Louisville Water Works. A one day trip to Louisville by car is anticipated. The contractor shall operate the CANARY event detection with field data provided by the telemetry equipment at the off-site test loop demonstration project. The contractor shall prepare one report for the EPA Water Technology Innovation Cluster providing the results of the CANARY integration project in Louisville. The contractor shall deliver the draft report one month before the end of the option year. EPA will provide comments within one week of delivery of the draft report. The contractor shall deliver a final report by the end of the option year.

The Contractor shall work with Urbanalta and Dan Murray to develop a combined storm water monitoring and CANARY event detection application. The contractor shall also assist the development of a Hydrant tamper sensor and alarm system.

Task 6: Development of a Pilot Scale Aircraft Drinking Water System
The contractor shall support construction of a pilot scale "mock" aircraft drinking water system. The system will consist of a storage on boarding tank (donated by Boeing), flexible polymer tubing and aircraft bathroom fixtures. The mock system will also include section of tubing that can be removed an analyzed for biofilm formation or adhered contaminant. The contractor shall ensure that the tank is full of tap water on a daily basis and that demand at the fixture is indicative of demand on an airplane in flight.

The contactor shall support injection of contaminants into the mock system. Contaminants will include hydrocarbons such as gasoline or jet fuel and microbial agents such as non pathogenic E. *coli* or *Bacillus* spores. The contractor shall monitor contaminant persistence and initiate decontamination if persistence is observed. Partnering airlines will provide their Standard operating decontamination procedures. The contractor shall employ decontamination measures such as flushing or adding a decontamination agent (disinfectants, surfactants, etc.) and compare them to the existing airline decon procedures. The contractor shall also monitor water quality parameters such as disinfectant residual, pH, temperature, etc. through grab samples and with

online sensors.

Task 7: Support for Treating Large Volumes of Water

Contractor shall transport the portable AOP trailer water treatment unit from Ft. Riley Kansas to the T&E facility. Once returned to the T&E facility, the contractor shall prepare a QAPP that describes how the AOP trailer works, the operation and maintenance of the treatment unit(s) and lays out a protocol for experiments on treatment of large volumes of water using the trailer. The focus contaminants will be *Bacillus* spores and (stable) cesium chloride. The experimental treatment protocol should be flexible enough that new treatment technologies and be added to the QAPP in place of the AOP trailer.

Once the QAPP is complete and approved, the contractor shall conduct treatment experiments using the AOP trailer. The contractor shall use the results of the report titled "Literature Review of current practices for the containment, treatment and disposal of large volume of contaminated water and wastewater" as a resource for new water treatment technologies that may be tested using the approved QAPP. The contractor completed this report during work assignment 4-07 under contract EP-C-09-041.

The contractor shall provide expert technical support on using advanced oxidations processes (AOP) for treatment of drinking water or wastewater containing *Bacillus* spores or organic chemicals. This expert support could come in the form of recommendations about how to improve existing treatment methods, literature searching, bench scale tests or conducting workshops with other technical experts on decontamination using AOP.

Task 8: Support for updating and developing Ohio River spill model with ORSANCO and GCWW

Contractor shall work with EPA, ORSANCO, and GCWW to revise and update the Ohio River Spill model. The current model used by ORSANCO and GCWW was originally written and compiled in the early 1990s in FORTRAN. The model was last updated by Walter Grayman and Global Quality in the early 2000s. The model will not be able to accept new data files from the USGS Cascades data. Therefore the model is in need of updating. EPA NHSRC will work with the contractor to incorporate additional security algorithms into the revised and updated river model. Source water event detection using the Java 5.0 version and upstream contaminant data programs shall be considered for inclusion into the new river model. The contractor may need to access subcontractor support which specializes in hydraulic modeling. The contractor shall prepare QA documentation and work with ORSANCO and GCWW to Beta test the revised model on the Cascade data files. Should a spill be reported during the Beta testing period, the revised model cannot also be validated in a real spill scenario. Due to firewall restrictions, the contractor may have to perform work activities at GCWW or ORSANCO computer locations. The overall goal of the project is to develop security software which can be applied to source water intake monitoring.

Quality Assurance

The contractor shall maintain a compendium of all applicable T&E SOPs for submittal to NHSRC QA manager such that future work can be cross referenced to existing SOPs. The contractor shall update existing QAPPs for sensor research and decontamination experiments to reflect new equipment which has been added and to include new contaminants and experimental protocols.

The contractor shall comply with all requirements as delineated on the "Quality Assurance Planning Requirement Form (QARF)" included with this extramural action, see attachments. The contractor shall prepare a QAPP in accordance with R-2 and R-5 and/or the attachment provided with the SOW. The QAPP must be approved prior to the start of any work. Additional information related to QA requirements can be found at: http://www.epa.gov/quality/qs-docs/r5-final.pdf

The contractor shall update existing project HASPs to include new contaminants. Any substantive changes to the specifications in the approved work plan shall be documented by the contractor as a revision to the HASP.

Reporting

The contractor shall provide a work plan that sets the contractor's approach, staffing, schedule, milestones, and estimated budget for the completion of the tasks under this work assignment. Monthly reports summarizing the status of this Work Assignment shall be completed and provided to the EPA CL-COR as part of the Work Assignment deliverables. The monthly reports shall;

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks,
- Summarize the planned activities anticipated for the upcoming period,
- Identify problems and resolutions encountered,
- Shall be used to evaluate the status and the progress of the work,
- Shall be used to resolve technical and/or budgeting problems, and
- Identify and demonstrate expenditures

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: **0-06**
Amendment 2

This amendment is adding Task 8.

TITLE:
Technical Support to National Homeland Security Research Center (NHSRC) Research projects at Test and Evaluation Facility (T&E) and field locations

EAS Title: Tech Support NHSRC Res Projects T&E & Field Sites

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
John Hall
U.S. Environmental Protection Agency
National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-487- 2814
email: hall.john@epa.gov

ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Jeff Szabo
U.S. Environmental Protection Agency
National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-487-2823
email: szabo.jeff@epa.gov

PERIOD OF PERFORMANCE:
June 1, 2014 to May 31, 2015

OBJECTIVE:
The objective of this Work Assignment shall be to provide technical support to the EPA in order to conduct controlled research and development (R&D) studies utilizing various distribution system simulators (DSS) and to test EPA developed detection and decontamination technologies and methods.

TECHNICAL SUPPORT
The contractor shall provide technical support to NHSRC projects at EPA's Test and Evaluation (T&E) research facility. These projects include testing and maintenance of various sensors and monitors under controlled conditions on the single pass distribution system simulator. The

contractor shall support EPA's bench and pilot scale decontamination initiatives. The contractor shall support the testing of event detection software using a variety of sensor equipment. The contractor shall continue to support guest researchers working on NHSRC projects at the T&E facility.

This work assignment shall provide technical support to NHSRC projects at field locations as required. The contractor will support transportation of equipment and supplies to and from Ft. Riley Kansas (i.e. horse trailer) and Louisville Water Works (CANARY testing) and Dayton Water Works (5 waters response curve).

Technical Direction will be used and supplied by the WACOR when needed, unless it increases the LOE or costs on this work assignment. Then the work assignment will be amended.

Task 1: Sensor Research

The contractor shall continue to investigate various sensor and monitoring devices for water security applications. The EPA WACOR shall identify (through written technical direction) sensor and monitoring devices for investigation. If needed, the contractor shall submit a standardized report for all sensor equipment investigated (i.e. letter report, S::CAN Spectrolyser, by H. Piao) as directed by the WACOR.

The contractor shall maintain existing water quality sensors and telemetry equipment in good working condition and in a state of readiness as the primary focus of this task. The contractor shall assure that each sensor and monitoring technology being investigated is maintained according to manufacturer's calibration protocols and procedures, including the purchase and use of all necessary consumables and reagents. The contractor shall assure that all data from all the sensors and monitors on the distributions system simulator and on the test manifold are on-line, checked for errors, and accessible. Any data offered to partners or collaborators shall be quality control checked.

The sensors and monitors shall receive tap water from the 3" single pass distribution system simulators (the single pass line). The contractor shall assure that the water introduced to the sensors and monitors is representative of the water flowing through the DSS test unit. The contractor shall provide flow to the 3" single pass system such that the free chlorine residual remains constant at the 80 and 1100 foot monitoring stations.

The contractor shall also plumb cooling water used at the T&E facility to the single pass distribution system for testing with recycled waters and to conserve water usage.

The contractor shall follow quality assurance, engineering control, and health and safety protocols and procedures described in the master QAPP for this contract.

The contractor shall maintain the following core equipment on the 3" single pass line. The sensor and monitoring technologies to be utilized are a combination of conventional off-the self,

innovative, promising technologies, sensor technologies, SCADA software enhancements, and micro- technologies. Some pieces of the above listed equipment may be relocated to other facilities during the contract year.

All S:CAN equipment with Monti:tool event detection software
Hach Laser Turbimeter
Hach GLI panel (free chlorine, turbidity, pH, conductivity, temperature)
Hach UVAS
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One (1) O/I TOC sensor
2 Realtech UVT
Optiqua Refractive Index sensor
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The contractor shall also keep the Intellisonde working on the decon loop.

Using technical direction, the EPA WACOR may request substitute equipment for sensor experiments that will be purchased in lieu of what is listed above.

The contractor shall continue sensor response to contamination tests on the 3" single pass 1200 foot pipeline in the high bay area when technically directed by the WACOR. Planned experiments focus on supporting other work assignments and federal agencies. Planned sensor experiments include, but are not limited to:

- Contractor shall prepare a report on the injections of sodium thiosulfate and sodium chloride for the Optiqua refractive index monitoring device and the ASA device and submit to EPA by the end of the option year
-
- Contractor shall work with EPA and the manufacturer to improve and acquire long term O&M data for the Beta Ram unit
- Contractor shall obtain water from Dayton and predict contaminant responses from 5 waters response curves, then perform sampling to compare curve fit.
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Based upon the results of the previous evaluations and current NHSRC priorities, the EPA WACOR may provide written technical direction to perform additional test runs on contaminants

or their surrogates. The contractor shall assist the EPA WACOR in the development of Equipment Reports for the Water ISAC or EPA internet sites.

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Aldicarb
4-methylcyclohexane methanol (MCHM)
Cyanide (sodium)
Fenamiphos
Fluoroacetate (sodium)
Mercuric (chloride)
Methyl parathion
Nicotine
Sodium chloride
Ecoli with and without sodium thiosulfate
Bacillus spores
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The contractor shall ensure the single pass DSS is flushed after contaminant injection trials and that baseline water quality is not affected by the presence of contamination.

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Task 2: Bench and Pilot Scale Decontamination Experiments

The contractor shall support pilot scale persistence and decontamination experiments using the decontamination loop with the attached Kennedy fire hydrant. *B. globigii* spores will be used as a contaminant, as will stable surrogate radionuclides (cesium, strontium, and/or cobalt) may also be examined. Contamination experiments will be performed by either using the fire hydrant to introduce contaminants into the loop or directly introducing contaminant into the pipe or through the recirculation tank. The efficacy of various decontamination methods (contaminant removal and or inactivation procedures) will be studied. This may include flushing of the pipe loop, increasing disinfectant dose (chlorine, chloramine, UV, ozone, chlorine dioxide, acidified nitrite, nitrous oxide and peracetic acid) or adding a decontaminating agent that will be determined by the WACOR through technical direction. The effects of introducing beneficial decontamination

agents such as germinants or surfactants may also be studied during this testing. If necessary, the contractor shall also support bench scale inactivation experiment with *Bacillus* spores to determine the optimal disinfectant concentration to use in the pipe loop.

The contractor shall assist EPA researchers with the design and fabrication of a representative drinking water infrastructure sample surface (i.e. coupon) within the decontamination loop. The contractor shall also provide enumeration and analytical support to determine the amount of contaminant adhered to the sample surfaces before and after decontamination. The contractor will assist the EPA WACOR in developing one report or one journal article on decontamination of contaminants adhered to water infrastructure. This report or journal article will be completed by the end of the option year.

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Task 3: New Equipment Purchases and/or Leases

The contractor may acquire some if not all of the following equipment and evaluate their performance. Additional sensor technologies may be evaluated for purchase by EPA and the contractor during the contract year. Letter reports for each piece of equipment tested shall be prepared in conjunction with EPA if directed by the WACOR.

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Once the QAPP is complete and approved, the contractor shall conduct treatment experiments using the AOP trailer. The contractor shall use the results of the report titled "Literature Review of current practices for the containment, treatment and disposal of large volume of contaminated water and wastewater" as a resource for new water treatment technologies that may be tested using the approved QAPP. The contractor completed this report during work assignment 4-07 under contract EP-C-09-041.

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Contractor shall work with EPA, ORSANCO, and GCWW to revise and update the Ohio River Spill model. The current model used by ORSANCO and GCWW was originally written and compiled in the early 1990s in FORTRAN. The model was last updated by Walter Grayman and Global Quality in the early 2000s. The model will not be able to accept new data files from the USGS Cascades data. Therefore the model is in need of updating. EPA NHSRC will work with the contractor to incorporate additional security algorithms into the revised and updated river model. Source water event detection using the Java 5.0 version and upstream contaminant data programs shall be considered for inclusion into the new river model. The contractor may need to access subcontractor support which specializes in hydraulic modeling. The contractor shall prepare QA documentation and work with ORSANCO and GCWW to Beta test the revised model on the Cascade data files. Should a spill be reported during the Beta testing period, the revised model cannot also be validated in a real spill scenario. Due to firewall restrictions, the contractor may have to perform work activities at GCWW or ORSANCO computer locations. The overall goal of the project is to develop security software which can be applied to source water intake monitoring.

Quality Assurance

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The contractor shall comply with all requirements as delineated on the "Quality Assurance Planning Requirement Form (QARF)" included with this extramural action, see attachments. The contractor shall prepare a QAPP in accordance with R-2 and R-5 and/or the attachment provided with the SOW. The QAPP must be approved prior to the start of any work. Additional information related to QA requirements can be found at: http://www.epa.gov/quality/qs-docs/r5-final.pdf

The contractor shall update existing project HASPs to include new contaminants. Any substantive changes to the specifications in the approved work plan shall be documented by the contractor as a revision to the HASP.

Reporting

The contractor shall provide a work plan that sets the contractor's approach, staffing, schedule, milestones, and estimated budget for the completion of the tasks under this work assignment. Monthly reports summarizing the status of this Work Assignment shall be completed and provided to the EPA CL-COR as part of the Work Assignment deliverables. The monthly reports shall;

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks,
- Summarize the planned activities anticipated for the upcoming period,
- Identify problems and resolutions encountered,
- Shall be used to evaluate the status and the progress of the work,
- Shall be used to resolve technical and/or budgeting problems, and
- Identify and demonstrate expenditures

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-08

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	QA & Tech Support for Water Se
	Base X Option Period Number	

Contractor: CB&I FEDERAL SERVICES LLC

Specify Section and paragraph of Contract SOW: Sec 3 #1 and 4

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full Title: Quality Assurance and Technical Support for the Water security Test Bed

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period: 06/01/2014 To 05/31/2015 — Cost/Fee: — LOE:

This Action:

Total:

Work Plan / Cost Estimate Approvals

Contractor WP Dated: — Cost/Fee: — LOE:

Cumulative Approved: — Cost/Fee: — LOE:

Work Assignment Manager Name: Jeff Szabo (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2823 FAX Number: 513-569-7052
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: 0-08

TITLE:
Quality Assurance and Technical Support for the Water Security Test Bed

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Jeff Szabo
U.S. Environmental Protection Agency
National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-487- 2823
email: szabo.jeff@epa.gov

ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE: (WACOR):
John Hall
U.S. Environmental Protection Agency
National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-487-2814
email: hall.john@epa.gov

PERIOD OF PERFORMANCE:
June 1, 2014 to May 31, 2015

BACKGROUND
EPA's National Homeland Security Research Center (NHSRC) has partnered with Idaho National Laboratory (INL) to build the Water Security Test Bed (WSTB) on the grounds of INL. The centerpiece of the WSTB will be 8-inch diameter drinking water pipe that has been taken out of service. The pipe was exhumed from the INL grounds (by INL personnel) and oriented in the shape of a small drinking water distribution system. The WSTB will have service connections to simulate water demands and removable coupons to sample pipe interiors. Experiments focused on contamination and decontamination will take place in the WSTB when it is constructed.

TECHNICAL SUPPORT:
This contractor shall provide quality assurance and technical support to EPA/NHSRC for contamination/decontamination and sensor experiments in the WSTB. The specific work assignment objectives are as follows:

- The contractor shall prepare quality assurance project plans (QAPP) for sensor and contamination/decontamination experiments in the WSTB
- The contractor shall provide technical support for certain design aspects of the WSTB,

installation of equipment housed at the T&E facility and execution of experiments

Task 1: Prepare Quality Assurance Project Plan and Health and Safety Plan

The contractor shall develop a QAPP for experiments that will be conducted in the WSTB related to infrastructure contamination/decontamination and detection of contamination with water quality sensors that trigger flushing fire hydrants.

The contractor shall use the QAPP titled "Germination of *B. globigii* spores and decontamination of a distribution system" as the basis for a new QAPP that covers contamination/decontamination experiments in the WSTB. The existing QAPP was used in WA 0-06 of contract EP-C-09-041 and will be used in WA 0-06 of contract EP-C-14-012. The contractor will work with the WACOR to scale up the contamination and decontamination protocols described in the existing QAPP and apply them to the WSTB. Since the WSTB is currently under construction, the specific aspects of scaling up contamination/decontamination experiments will be determined by the WACOR through technical direction.

The contractor shall use the QAPP titled "Sensor Studies for Technical Support to NHSRC Research Projects at Test and Evaluation Facility and Field Locations" as the basis for a new QAPP that covers experiments on sensor detection and flushing hydrants. The existing QAPP was used in WA 0-06 of contract EP-C-09-041 and will be used in WA 0-06 of contract EP-C-14-012. The contractor will work with the WACOR to scale up the sensor detection and fire hydrant flushing protocols described in the existing QAPP and apply them to the WSTB. The contractor will work with the WAM to develop a QAPP for portable disinfection systems to be tested between the two fire hydrants. Since the WSTB is currently under construction, the specific aspects of scaling up contamination/decontamination experiments will be determined by the WACOR through technical direction.

For all QAPP's, the contractor shall develop standard operating procedures (SOP) for conducting a contamination/decontamination or sensor/flushing hydrant and portable disinfection experiments in the WSTB. These SOPs will be referenced in future QAPPs that use different contaminants.

The contractor shall comply with all requirements as delineated on the "Quality Assurance Planning Requirement Form (QARF)" included with this extramural action, see attachments. The contractor shall prepare QAPPs in accordance with R-2 and R-5 and/or the attachment provided with the PWS. The QAPP must be approved prior to the start of any work. Additional information related to QA requirements can be found at: http://www.epa.gov/quality/qs-docs/r5-final.pdf.

The contractor shall create a health and safety plan (HASP) to for experiments described in each QAPP.

The WACOR will review the documents within 14 days of delivery and may request changes. If changes are required, the contractor shall implement those corrections within 14 days.

Task 2: Technical Support for the WSTB Design

The contractor shall provide technical support to the EPA WACOR for the following WSTB design considerations:

- Methods of injecting contamination into the WSTB
- Techniques for introduction of decontaminating agents into the WSTB
- Installation of water quality sensors and telemetry
- Installation and testing of portable disinfection systems.
- Installation of standard fire hydrants and fire hydrants with flushing attachments
- Installation of flow meters and check valves
- Shipping of water and infrastructure samples to the T&E facility from INL for analysis

The contractor shall provide technical support for the procurement, transport, installation and/or start up support of the following equipment:

- Water quality sensors such as free/total chlorine, pH, temperature, and UV/VIS
- Standard fire hydrants, valving and flushing fire hydrant systems
- Flow meters which alarm for backflow events
- Fire hydrant tampering detection sensors
- Telemetry and SCADA systems to receive field data from INL at the T&E facility in Cincinnati or other specified locations.
- Household bathroom and utility room fixtures
- Injection pumps
- Decontaminating agents such as chlorine dioxide

It is expected that the contractor will need to send 1 to 2 personnel to INL on two occasions to support implementation of the items listed in this task.

The contractor shall provide a report that includes: a description of the WSTB, how contaminant injections were performed, how decontamination was performed, analyses of data collected from experiments in the WSTB including the degree of attachment of *Bacillus* spores and the effectiveness of decontamination.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-08

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	QA & Tech Support for Water Se
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Section 3, paragraph 1 and 4

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full Title: QA & Tech Support for Water Security Test Bed. The purpose of this amendement is to have the contractor provide additional support for writing the report that will summarize the work performed at Idaho National Lab.

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (*Max 2*) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 06/01/2014 To 05/31/2015		1,270
This Action:		305
Total:		1,575

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Jeff Szabo	Branch/Mail Code:
(Signature) (Date)	Phone Number: 513-487-2823
	FAX Number: 513-569-7052
Project Officer Name: Ruth Corn	Branch/Mail Code:
(Signature) (Date)	Phone Number: 513-569-7920
	FAX Number:
Other Agency Official Name	Branch/Mail Code:
(Signature) (Date)	Phone Number:
	FAX Number:
Contracting Official Name: Mark Cranley	Branch/Mail Code:
(Signature) (Date)	Phone Number: 513-487-2351
	FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: 0-08, Amendment 1

TITLE:
Quality Assurance and Technical Support for the Water Security Test Bed

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Jeff Szabo
U.S. Environmental Protection Agency
National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-487- 2823
email: szabo.jeff@epa.gov

ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE: (WACOR):
John Hall
U.S. Environmental Protection Agency
National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-487-2814
email: hall.john@epa.gov

PERIOD OF PERFORMANCE:
June 1, 2014 to May 31, 2015

BACKGROUND
EPA's National Homeland Security Research Center (NHSRC) has partnered with Idaho National Laboratory (INL) to build the Water Security Test Bed (WSTB) on the grounds of INL. The centerpiece of the WSTB will be 8-inch diameter drinking water pipe that has been taken out of service. The pipe was exhumed from the INL grounds (by INL personnel) and oriented in the shape of a small drinking water distribution system. The WSTB will have service connections to simulate water demands and removable coupons to sample pipe interiors. Experiments focused on contamination and decontamination will take place in the WSTB when it is constructed.

TECHNICAL SUPPORT:
This contractor shall provide quality assurance and technical support to EPA/NHSRC for contamination/decontamination and sensor experiments in the WSTB. The specific work assignment objectives are as follows:

- The contractor shall prepare quality assurance project plans (QAPP) for sensor and contamination/decontamination experiments in the WSTB
- The contractor shall provide technical support for certain design aspects of the WSTB,

installation of equipment housed at the T&E facility and execution of experiments

Task 1: Prepare Quality Assurance Project Plan and Health and Safety Plan

The contractor shall develop a QAPP for experiments that will be conducted in the WSTB related to infrastructure contamination/decontamination and detection of contamination with water quality sensors that trigger flushing fire hydrants.

The contractor shall use the QAPP titled "Germination of *B. globigii* spores and decontamination of a distribution system" as the basis for a new QAPP that covers contamination/decontamination experiments in the WSTB. The existing QAPP was used in WA 0-06 of contract EP-C-09-041 and will be used in WA 0-06 of contract EP-C-14-012. The contractor will work with the WACOR to scale up the contamination and decontamination protocols described in the existing QAPP and apply them to the WSTB. Since the WSTB is currently under construction, the specific aspects of scaling up contamination/decontamination experiments will be determined by the WACOR through technical direction.

The contractor shall use the QAPP titled "Sensor Studies for Technical Support to NHSRC Research Projects at Test and Evaluation Facility and Field Locations" as the basis for a new QAPP that covers experiments on sensor detection and flushing hydrants. The existing QAPP was used in WA 0-06 of contract EP-C-09-041 and will be used in WA 0-06 of contract EP-C-14-012. The contractor will work with the WACOR to scale up the sensor detection and fire hydrant flushing protocols described in the existing QAPP and apply them to the WSTB. The contractor will work with the WAM to develop a QAPP for portable disinfection systems to be tested between the two fire hydrants. Since the WSTB is currently under construction, the specific aspects of scaling up contamination/decontamination experiments will be determined by the WACOR through technical direction.

For all QAPP's, the contractor shall develop standard operating procedures (SOP) for conducting a contamination/decontamination or sensor/flushing hydrant and portable disinfection experiments in the WSTB. These SOPs will be referenced in future QAPPs that use different contaminants.

The contractor shall comply with all requirements as delineated on the "Quality Assurance Planning Requirement Form (QARF)" included with this extramural action, see attachments. The contractor shall prepare QAPPs in accordance with R-2 and R-5 and/or the attachment provided with the SOW. The QAPP must be approved prior to the start of any work. Additional information related to QA requirements can be found at: http://www.epa.gov/quality/qs-docs/r5-final.pdf.

The contractor shall create a health and safety plan (HASP) to for experiments described in each QAPP.

The WAM will review the documents within 14 days of delivery and may request changes. If changes are required, the contractor shall implement those corrections within 14 days.

Task 2: Technical Support for the WSTB Design
The contractor shall provide technical support to the EPA WACOR for the following WSTB design considerations:

- Methods of injecting contamination into the WSTB
- Techniques for introduction of decontaminating agents into the WSTB
- Installation of water quality sensors and telemetry
- Installation and testing of portable disinfection systems.
- Installation of standard fire hydrants and fire hydrants with flushing attachments
- Installation of flow meters and check valves
- Shipping of water and infrastructure samples to the T&E facility from INL for analysis

The contractor shall provide technical support for the procurement, transport, installation and/or start up support of the following equipment:

- Water quality sensors such as free/total chlorine, pH, temperature, and UV/VIS
- Standard fire hydrants, valving and flushing fire hydrant systems
- Flow meters which alarm for backflow events
- Fire hydrant tampering detection sensors
- Telemetry and SCADA systems to receive field data from INL at the T&E facility in Cincinnati or other specified locations.
- Household bathroom and utility room fixtures
- Injection pumps
- Decontaminating agents such as chlorine dioxide

It is expected that the contractor will need to send 1 to 2 personnel to INL on two occasions to support implementation of the items listed in this task.

The contractor shall provide a report that includes: a description of the WSTB, how contaminant injections were performed, how decontamination was performed, analyses of data collected from experiments in the WSTB including the degree of attachment of *Bacillus* spores and the effectiveness of decontamination.

Under amendment 1, the contractor shall provide additional support for three aspects of the report. First, the contractor shall summarize the performance of the WaterStep mobile water treatment device. This unit was used to treat water that was flushed from the WSTB into a lagoon. Second, the contractor shall summarize and present free chlorine and TOC data from the Hach CL-17 and RealTech online monitoring devices, respectively. Any data trends that emerge

from this analysis will be explained. Finally, the contractor shall summarize the performance of the Mueller Hydroguard automated fire hydrant flushing device during the triggered flushing experiment.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-07

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Tech Transfer Innov Cluster
	Base X Option Period Number	

Contractor: CB&I FEDERAL SERVICES LLC

Specify Section and paragraph of Contract SOW: Section 3; #1 and #5

Purpose:
- ☒ Work Assignment
- ☐ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 12/01/2014 To 05/31/2015

Comments:
Full Title:Technical Support to EPA's Technology Transfer Innovation Cluster

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 06/01/2014 To 05/31/2015		0
This Action:		373
Total:		373

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Julius Enriquez	(Signature)	(Date)	Branch/Mail Code:
			Phone Number: 513-569-7285
			FAX Number:
Project Officer Name: Ruth Corn	(Signature)	(Date)	Branch/Mail Code:
			Phone Number: 513-569-7920
			FAX Number:
Other Agency Official Name	(Signature)	(Date)	Branch/Mail Code:
			Phone Number:
			FAX Number:
Contracting Official Name: Mark Cranley	(Signature)	(Date)	Branch/Mail Code:
			Phone Number: 513-487-2351
			FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract No.: **EP-C-14-012**
WA 0-07

TITLE: Technical Support to EPA's Technology Transfer Innovation Cluster
EAS Title: Tech Support EPA's Tech Transfer Innov Cluster

WORK ASSIGNMENT CONTRACT OFFICER REPRESENTATIVE (WACOR)

Julius Enriquez
U.S. Environmental Protection Agency
National Risk Management Research Laboratory
Cincinnati, Ohio 45268
Phone: 513-569-7285
email: Enriquez.julius@epa.gov

ALTERNATIVE WACOR

Evelyn Hartzell
U.S. Environmental Protection Agency
National Risk Management Research Laboratory
Cincinnati, Ohio 45268
Phone: 513-569-
email: hartzell.evelyn@epa.gov

PERIOD OF PERFORMANCE: Date of Award to May 31, 2015

BACKGROUND:

The U.S. government spends billions of dollars annually on research and development (R&D) which has been critically important to the strength of the American economy. Unfortunately, only a small portion of the resulting discoveries have been commercialized by the private sector. As our global competitors accelerate investments in R&D, and increasingly commercialize products and processes, it is imperative that the U.S. optimize its commercial output from federally-funded research to benefit public health and well-being, create jobs and increase economic value. As a response to this, early in 2010, EPA Cincinnati took the lead and initiated the Water Technology Cluster (WTC) program to catalyze a public-private partnership for commercializing water related technology in the Southwest Ohio, Northern Kentucky and Southeast Indiana Region. This charge followed the priorities of EPA to protect human health and the environment while supporting economic development efforts and incorporated goals of the Office of Water Drinking Water Strategy.

The importance of public-private partnerships is established under the United States Federal Technology Transfer Act (FTTA) of 1986 (P.L. 99-502), after the Stevenson-Wydler Technology Innovation Act of 1980, the second major piece of legislation focused on technology transfer (T2) from federal government agencies to the commercial sector. The act enabled federal laboratories to enter into Cooperative Research and Development Agreements (CRADAs) and to negotiate licenses for patented inventions made at the laboratory. This was reinforced by the October 28, 2011 Presidential Memorandum on *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Business*. Such a "Community" would provide new ways to better engage U.S. Industry at the early stages of federal discovery. This allows the commercial value of such discoveries to be identified early in the research process, and fosters industry-federal partnerships that join forces and more effectively pull the technology toward mutual goals at the earliest possible time. The EPA plans to create more awareness across U.S. industries and other non-government organizations about the specialized federal research resources (people, lands, and facilities) available through T2 agreements authorized by:

- Stevenson-Wydler Technology Innovation Act and Bayh-Dole Act of 1980
- Federal Technology Transfer Act (15 USC 3710a) of 1986
- Executive Order 12591 of 1987
- National Technology Transfer and Advancement Act of 1995
- Technology Transfer Commercialization Act of 2000, and
- America Competes Act.

RELEVANCE:

Today, EPA seeks to transfer technologies into the private sector and collaborate on environmental research and development projects with industry, academia, trade associations, and state and local agencies to promote the national cluster effort.

An integral component of the agency's strategy is the work to become a high performing organization. We are undertaking efforts to attract and retain the workforce of the future, modernize our business practices and more fully employ new tools and technologies. We are implementing or accelerating a number of key efforts, including realigning our workspace, launching new collaboration tools, and implementing lean business processes to bring about change and efficiency at the EPA. We are realigning resources and staff to ensure the success of these efforts. This is not an effort to just save money; the EPA is looking toward the future at ways to better serve the American people.

EPA is building sustainability into our day-to-day operations in partnership with businesses, government and other stakeholders. As problems become more complicated we need new

technology tools, technical support and approaches to meet the challenges. We need new and innovative ways to deal with threats to human health and the environment that cannot be effectively managed through regulations alone, or for which there are no existing regulations.

Wherever possible, the agency is seeking to grow its capacity to provide support, outreach and exposure for cluster-related technology transfer and the innovations and technologies being conceived, designed, and planned as part of the capabilities of the research in connection to WTC and U.S. EPA Test and Evaluation (T&E) Facility. This should be accomplished through various cross water media technologies and coordination mechanisms. These efforts will build on where we are and promote greater cross water collaboration and innovation to allow EPA to continue to move forward to a more sustainable future for technology transfer.

As such, science and research continue to be the foundation of our work at the EPA. Superior, rigorous science leads to shared innovative solutions to complex environmental challenges. The EPA is focusing research on the most critical issues facing the agency, ensuring the best scientific underpinning for regulatory actions and finding more sustainable solutions for environmental issues.

Objective:
This PWS is in support of EPA's Goal 2: Protecting America's Water.

Technical Qualifications

It is important that EPA become familiar with the key metrics for technology transfer success. The ideal technical support individual or team preferably have at least 3 years of prior experience working on T2 activities, and:

- Have an excellent understanding of a commercialization model as it relates to the technology transfer continuum. Examples include "Goldsmith Technology Commercialization Model" and "Stage Gate System Model" to launch and move technology through development to private sector commercialization and marketing.
- Have experience with clusters or similar business/technology development program or groups. Experience should include an understanding of the phases, dynamics and changes of maturity of technology in the private sector.
- Demonstrate an understanding of the success and failure of business/technology clusters/groups/networks/hubs.
- Understand economic development as it relates to; infrastructure, human resources, technology, and financial resources and regulatory policies.

TECHNICAL SUPPORT
Promote technologies being conceived, designed, and planned as part of the capabilities of the research at the T&E facility, Cincinnati, Ohio and in connection to the various water matrixes

related to activates connected with the WTC.

Technology Transfer Tasks:
The contractor shall provide:

Task 1. Support in technology transfer, outreach, and exposure of EPA water related media technologies which are being conceived, designed, and planned at the T&E facility and in connection to the EPA Cincinnati WTIC. This support shall include the evaluation and assessments of technology being developed at the T&E Facility and in connection to the EPA cluster research.

Task 2. Technical support to develop, design and deploy an innovative lab-to-market technology transfer mechanism/process/program. The contractor shall provide the necessary expertise to examine, make recommendations, and identify best practices and strategies to maximize EPA's technology transfer activities and processes. This shall include development of a white paper on the "ideal government model technology transfer program", specifically on water technologies that address environmental pollution and /or remediation. The ultimate goal is to identify possible synergies with the private sector that will lead to the technology transfer and licensing of new and innovative water matrix technologies.

Task 3 Support to EPA Cincinnati with strategies and plans to effectively promote promising technologies and capabilities developed in connections with the T&E Facilities and EPA Cincinnati Research. Contractor shall handle outreach and promotion of technology transfer with the private sector and other federal agencies through the use of webinars, workshops, and publications in the area of effective federal technology transfer. This effort should also include strengthening of Agency partnerships with other federal and state agencies, local governments, non-government organizations, academia and private companies committed to technology transfer and supporting national, regional, and local efforts to improve and protect human health and the environment, with an emphasis on the water matrix.

Task 4. The contractor shall develop metrics and tools that can

- be used to support the monitoring of EPA T2 activities and
- measure success outcomes of EPA T2 Activities.

Management Plans and Deliverables:

Work Plan
The contractor shall provide a work plan that sets the contractor's approach, staffing, schedule, milestones, deliverables and estimated budget for the completion of the tasks under this work assignment. Secondary analytical data may be collected and as such the contractor will develop

an appropriate Quality Assurance Project Plan (QAPP). The contractor shall develop as needed an appropriate Health and Safety Plan (HASP) to accommodate any off-site visits.

Monthly Reports
Updates on the status of the work assignment shall be provided to the EPA CL-COR and WACOR once a month. Delivery dates will be discussed at the first meeting. The monthly reports shall:

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks as per the work plan
- Summarize the planned activities anticipated for the upcoming period
- Identify problems and resolutions encountered
- Be used to evaluate the status and the progress of the work
- Be used to resolve technical and/or budgeting problems, and
- Identify and demonstrate expenditures.

Work Assignment Meetings and Reports
Project meetings shall be conducted once per month or as often as needed by the WACOR with advice from the technical coordinator to assure the completion of the efforts. The meeting schedule can be changed by mutual agreement. The contractor shall provide at a minimum the following at each meeting.

- Status and progress of the technical and consultation support efforts
- Planned activities for the upcoming period
- Problems encountered and resolutions
- Budget information.

The contractor shall summarize project meetings and submit it to the EPA CL-COR and WACOR within five (5) working days of the project meeting. The submitted report shall be in an agreed upon format. Report shall be provided via E-mail.

Draft Summary Reports
The contractor shall submit to the EPA three (3) quarterly summary reports of the consultation efforts on the technology transfer tasks and the EPA cluster task. The report shall document the path of discovery and include: title, update status, path forward, and recommendations & observations. The first quarterly report shall be provided to the EPA WACOR 30 calendar days after the completion of the first quarter.

The contractor shall submit for this PWS a white paper on the "ideal government model technology transfer program". This shall include; executive summary, background, and best practices and recommendations.

The contractor shall submit for this PWS a summary report on the discussions and an outline of

the report format.

PERFORMANCE WORK STATEMENT
EPA Contract No.: **EP-C-14-012**
WA 0-07

TITLE: Technical Support to EPA's Technology Transfer Innovation Cluster
EAS Title: Tech Support EPA's Tech Transfer Innov Cluster

WORK ASSIGNMENT CONTRACT OFFICER REPRESENTATIVE (WACOR)

Julius Enriquez
U.S. Environmental Protection Agency
National Risk Management Research Laboratory
Cincinnati, Ohio 45268
Phone: 513-569-7285
email: Enriquez.julius@epa.gov

ALTERNATIVE WACOR

Evelyn Hartzell
U.S. Environmental Protection Agency
National Risk Management Research Laboratory
Cincinnati, Ohio 45268
Phone: 513-569-
email: hartzell.evelyn@epa.gov

PERIOD OF PERFORMANCE: Date of Award to May 31, 2015

BACKGROUND:

The U.S. government spends billions of dollars annually on research and development (R&D) which has been critically important to the strength of the American economy. Unfortunately, only a small portion of the resulting discoveries have been commercialized by the private sector. As our global competitors accelerate investments in R&D, and increasingly commercialize products and processes, it is imperative that the U.S. optimize its commercial output from federally-funded research to benefit public health and well-being, create jobs and increase economic value. As a response to this, early in 2010, EPA Cincinnati took the lead and initiated the Water Technology Cluster (WTC) program to catalyze a public-private partnership for commercializing water related technology in the Southwest Ohio, Northern Kentucky and Southeast Indiana Region. This charge followed the priorities of EPA to protect human health and the environment while supporting economic development efforts and incorporated goals of the Office of Water Drinking Water Strategy.

The importance of public-private partnerships is established under the United States Federal Technology Transfer Act (FTTA) of 1986 (P.L. 99-502), after the Stevenson-Wydler Technology Innovation Act of 1980, the second major piece of legislation focused on technology transfer (T2) from federal government agencies to the commercial sector. The act enabled federal laboratories to enter into Cooperative Research and Development Agreements (CRADAs) and to negotiate licenses for patented inventions made at the laboratory. This was reinforced by the October 28, 2011 Presidential Memorandum on *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Business*. Such a "Community" would provide new ways to better engage U.S. Industry at the early stages of federal discovery. This allows the commercial value of such discoveries to be identified early in the research process, and fosters industry-federal partnerships that join forces and more effectively pull the technology toward mutual goals at the earliest possible time. The EPA plans to create more awareness across U.S. industries and other non-government organizations about the specialized federal research resources (people, lands, and facilities) available through T2 agreements authorized by:

- Stevenson-Wydler Technology Innovation Act and Bayh-Dole Act of 1980
- Federal Technology Transfer Act (15 USC 3710a) of 1986
- Executive Order 12591 of 1987
- National Technology Transfer and Advancement Act of 1995
- Technology Transfer Commercialization Act of 2000, and
- America Competes Act.

RELEVANCE:

Today, EPA seeks to transfer technologies into the private sector and collaborate on environmental research and development projects with industry, academia, trade associations, and state and local agencies to promote the national cluster effort.

An integral component of the agency's strategy is the work to become a high performing organization. We are undertaking efforts to attract and retain the workforce of the future, modernize our business practices and more fully employ new tools and technologies. We are implementing or accelerating a number of key efforts, including realigning our workspace, launching new collaboration tools, and implementing lean business processes to bring about change and efficiency at the EPA. We are realigning resources and staff to ensure the success of these efforts. This is not an effort to just save money; the EPA is looking toward the future at ways to better serve the American people.

EPA is building sustainability into our day-to-day operations in partnership with businesses, government and other stakeholders. As problems become more complicated we need new

technology tools, technical support and approaches to meet the challenges. We need new and innovative ways to deal with threats to human health and the environment that cannot be effectively managed through regulations alone, or for which there are no existing regulations.

Wherever possible, the agency is seeking to grow its capacity to provide support, outreach and exposure for cluster-related technology transfer and the innovations and technologies being conceived, designed, and planned as part of the capabilities of the research in connection to WTC and U.S. EPA Test and Evaluation (T&E) Facility. This should be accomplished through various cross water media technologies and coordination mechanisms. These efforts will build on where we are and promote greater cross water collaboration and innovation to allow EPA to continue to move forward to a more sustainable future for technology transfer.

As such, science and research continue to be the foundation of our work at the EPA. Superior, rigorous science leads to shared innovative solutions to complex environmental challenges. The EPA is focusing research on the most critical issues facing the agency, ensuring the best scientific underpinning for regulatory actions and finding more sustainable solutions for environmental issues.

Objective:
This PWS is in support of EPA's Goal 2: Protecting America's Water.

Technical Qualifications

It is important that EPA become familiar with the key metrics for technology transfer success. The ideal technical support individual or team preferably have at least 3 years of prior experience working on T2 activities, and:

- Have an excellent understanding of a commercialization model as it relates to the technology transfer continuum. Examples include "Goldsmith Technology Commercialization Model" and "Stage Gate System Model" to launch and move technology through development to private sector commercialization and marketing.
- Have experience with clusters or similar business/technology development program or groups. Experience should include an understanding of the phases, dynamics and changes of maturity of technology in the private sector.
- Demonstrate an understanding of the success and failure of business/technology clusters/groups/networks/hubs.
- Understand economic development as it relates to; infrastructure, human resources, technology, and financial resources and regulatory policies.

TECHNICAL SUPPORT
Promote technologies being conceived, designed, and planned as part of the capabilities of the research at the T&E facility, Cincinnati, Ohio and in connection to the various water matrixes

related to activates connected with the WTC.

Technology Transfer Tasks:
The contractor shall provide:

Task 1. Support in technology transfer, outreach, and exposure of EPA water related media technologies which are being conceived, designed, and planned at the T&E facility and in connection to the EPA Cincinnati WTIC. This support shall include the evaluation and assessments of technology being developed at the T&E Facility and in connection to the EPA cluster research.

Task 2. Technical support to develop, design and deploy an innovative lab-to-market technology transfer mechanism/process/program. The contractor shall provide the necessary expertise to examine, make recommendations, and identify best practices and strategies to maximize EPA's technology transfer activities and processes. This shall include development of a white paper on the "ideal government model technology transfer program", specifically on water technologies that address environmental pollution and /or remediation. The ultimate goal is to identify possible synergies with the private sector that will lead to the technology transfer and licensing of new and innovative water matrix technologies.

Task 3 Support to EPA Cincinnati with strategies and plans to effectively promote promising technologies and capabilities developed in connections with the T&E Facilities and EPA Cincinnati Research. Contractor shall handle outreach and promotion of technology transfer with the private sector and other federal agencies through the use of webinars, workshops, and publications in the area of effective federal technology transfer. This effort should also include strengthening of Agency partnerships with other federal and state agencies, local governments, non-government organizations, academia and private companies committed to technology transfer and supporting national, regional, and local efforts to improve and protect human health and the environment, with an emphasis on the water matrix.

Task 4. The contractor shall develop metrics and tools that can

- be used to support the monitoring of EPA T2 activities and
- measure success outcomes of EPA T2 Activities.

Management Plans and Deliverables:

Work Plan
The contractor shall provide a work plan that sets the contractor's approach, staffing, schedule, milestones, deliverables and estimated budget for the completion of the tasks under this work assignment. Secondary analytical data may be collected and as such the contractor will develop

an appropriate Quality Assurance Project Plan (QAPP). The contractor shall develop as needed an appropriate Health and Safety Plan (HASP) to accommodate any off-site visits.

Monthly Reports
Updates on the status of the work assignment shall be provided to the EPA CL-COR and WACOR once a month. Delivery dates will be discussed at the first meeting. The monthly reports shall:

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks as per the work plan
- Summarize the planned activities anticipated for the upcoming period
- Identify problems and resolutions encountered
- Be used to evaluate the status and the progress of the work
- Be used to resolve technical and/or budgeting problems, and
- Identify and demonstrate expenditures.

Work Assignment Meetings and Reports
Project meetings shall be conducted once per month or as often as needed by the WACOR with advice from the technical coordinator to assure the completion of the efforts. The meeting schedule can be changed by mutual agreement. The contractor shall provide at a minimum the following at each meeting.

- Status and progress of the technical and consultation support efforts
- Planned activities for the upcoming period
- Problems encountered and resolutions
- Budget information.

The contractor shall summarize project meetings and submit it to the EPA CL-COR and WACOR within five (5) working days of the project meeting. The submitted report shall be in an agreed upon format. Report shall be provided via E-mail.

Draft Summary Reports
The contractor shall submit to the EPA three (3) quarterly summary reports of the consultation efforts on the technology transfer tasks and the EPA cluster task. The report shall document the path of discovery and include: title, update status, path forward, and recommendations & observations. The first quarterly report shall be provided to the EPA WACOR 30 calendar days after the completion of the first quarter.

The contractor shall submit for this PWS a white paper on the "ideal government model technology transfer program". This shall include; executive summary, background, and best practices and recommendations.

The contractor shall submit for this PWS a summary report on the discussions and an outline of

the report format.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-09

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Water-Energy Optimization Syst
	Base X Option Period Number	

Contractor: CB&I FEDERAL SERVICES LLC

Specify Section and paragraph of Contract SOW: Section 3 No. 1-5

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full title: Water-Energy Optimization System Development

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period: 06/01/2014 To 05/31/2015	Cost/Fee:	LOE: 0
This Action:		2,412
Total:		2,412

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee:	LOE:
Cumulative Approved:	Cost/Fee:	LOE:

Work Assignment Manager Name: Jeff Yang (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7655 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name: (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

Performance Work Statement
Contract No. **EP-C-14-012**
WA 0-09

TITLE: Water-Energy Optimization System Development

Work Assignment Manager:

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PERIOD OF PERFORMANCE: June 1, 2014 through May 31, 2015

Background

US EPA is implementing a series of research systematically planned and organized in the Safe and Sustainable Water Resources (SSWR) Research Action Plan. One of the projects is "Developing and Commercializing Smart Water Platform – Sensor-based Data-driven Energy-Water Optimization in Water Supplies". This project, as a part of the EPA Water Resources Adaptation Program (WRAP) activities, is built upon the CRADA between USEPA-General Electric (GE) #604-10 and its amendment No.1 #1-604-A-13.

This project is to develop a data-driven sensor-based optimization system. The technology aims to assist stakeholders in optimizing their water supply system for better compliance to SDWA regulations and for energy saving in water treatment and distribution. USEPA has implemented individual research activities related to the technology development. The EPA researchers are now incorporating the existing research results and further developing a technology platform EPA-Energy Water Optimization System (EPA-EWOS), also known as the SmartWater system. The development has been conducted with agreements that EPA has entered into with General Electric, the Greater Cincinnati Water Works (GCWW), and other private organizations and individuals. The current development is focused at the completion of system development by

field demonstration and further development at the GCWW's water system.

Project Description

This work assignment is to obtain technical service to continue the support of SmartWater development and demonstration at the GCWW's water system. Last year, the Contractor assisted EPA to having implemented a series of research and development activities for preparation of the upcoming site demonstration and system development.

In concept, the EPA-EWOS consists of four major components: 1) Central monitoring and control unit; 2) Distribution monitoring and control module; 3) Water treatment module based on EPA's water treatment plant – climate change adaptation model (WTP-ccam); and 4) An interactive graphic user interface (GUI). The final product will provide real-time streamlined monitoring and process control, and will manage drinking water treatment and distribution either as a single system, or independently in modules. It aims to significantly reduce water supply energy consumption, up to 15%, and to improve regulatory compliance over residual chlorine and disinfection by-products (DBP) at consumer's tap.

Adaptive monitoring, data-driven system optimization, and model-based process control are the core of innovative technologies under development. Sensor-based data acquisition and communication is the enabling technology. In process engineering, the WTP-ccam module monitors the changes in source water and treatment processes. Imbedded algorithms assist plant operators in adapting the process operations in real time to water demand and source water variations. Real-time monitoring data of the product water are fed to the second system module that monitors and controls water distribution. Through this system approach, EPA-EWOS is expected to help deliver water to consumers at the highest system-level efficiency.

To accomplish the project objective, the Contractor shall contact the EPA WACOR for clarifications on technical directions, if necessary. Meetings will be required at the start of the project to discuss details of the project tasks and subtasks. The system will utilize existing technologies, some patented, including GE's Proficy® database and Troubleshooter®, GE's SCADA control technologies, and EPA's adaptive technology (US Patent 7,866,204 B2). The process and control are integrated with the existing EPANET, EPANET-MSX, and EPA water quality models.

Process engineering for water system monitoring and controls

EPA is conducting a process engineering design and establishing engineering specifications for system monitoring and controls. Specifically, water treatment and distribution models, as well as central control – optimization models are being developed in separate EPA projects. These model results, when completed from other projects, will be used in this project as the basis for process engineering.

The process engineering on water treatment has three objectives: 1) transfer model inputs/outputs into monitoring and engineering control algorithms and control sequences in unit processing; 2)

configure the process sequence for interaction with SCADA systems; and 3) configure inputs of monitoring data and process information in a manner working with the distributed data acquisition system to be engineered by GE representative at the GCWW. It should be noted that all monitoring functions are designed using the existing Miller Plant SCADA system. The control feed loop will be conducted in a test dry-run using computer model simulations.

The water distribution system is currently being studied at the Cheery Grove segment of the GCWW distribution system. GCWW is conducting a series of network modeling and data acquisition in this distribution segment. Thus the distribution portion of this project should be closely coordinated with GCWW activities. At the same time, this project has its own objectives including water demand projections, network leakage and water loss modeling, data acquisition, and water quality / hydraulic modeling and verification.

This brief and concise description is for general understanding of the overall project. The Contractor shall contact WACOR or his/her representative for a complete and accurate understanding of the entire project, when such activity is necessary to complete specific work assignment as stated below.

The entire development is subdivided into two phases. The first is related to site demonstration design and system development for the GCWW systems. Upon the completion of data collection and network modeling, EPA along with the Contractor shall develop a full set of demonstration design, produce specifications for the Contractor to produce the demonstration prototype and conduct demonstration activities.

For this contract year, the work assignment includes three activities: 1) analyze the testing sites for design and testing of the prototype EPA-EWOS; 2) engineer and construct the prototype EPA-EWOS for testing according to provided specifications; and 3) perform the site installation and prepare the prototype for testing by April 2015. Through contractual protocols, EPA WACOR or his/her designee(s) may require additional technical support on other related project activities

Specific work assignment tasks are as follows:

Task 1 Developing a Prototype system and preparing for site demonstration

In this task, the Contractor shall construct the prototype under EPA's technical directions, and perform necessary project functions from acquiring instruments, equipment, software, engineering services, to any others necessary for construction of the functional prototype system. The site demonstration at GCWW is tentatively planned at this time, and will need to be confirmed. The testing sites include the Richard Miller water treatment plant and the Cherry Grove segment of the distribution network.

Activity No.1-1

The Contractor shall continue and complete several activities at the Richard Miller plant and assist EPA to design the optimization scheme for EPA-EWOS construction. These activities are:

- Complete and compare the data for online zeta potential and TOC reactivity monitoring. This is to compile the experimental data acquired last year and perform preliminary analysis in a report to EPA.

- Start working on and complete data collection for sedimentation basin flow modeling. GCWW supplied to EPA some limited bathometry drawing of the sedimentation basins. These dated engineering drawings require verification. The Contractor shall arrange and conduct the verification and work with EPA WAM for flow modeling and optimization assessment.

- Assist EPA in data acquisition and data connection with the plant monitoring system. Additional data monitoring and acquisition may be required, but this possibility is small at this time.

Activity No.1-2

The Contractor shall continue, coordinate, and complete activities on the Cherry Grove distribution network modeling and operational optimization. These activities include, but not limited to:

- Complete the acquisition of communication Gateways for real-time water demand data acquisition. This work is coordinated through GCWW with Neptune Corporation and its affiliates. Upon completion of the testing, the Contractor shall secure the data and provide to EPA in GIS usable forms.

- Assist in EPANet network modeling of water quality parameters. In this work, the Contractor shall coordinate with GCWW and, when required, install inline water quality monitoring devices (1-2 locations) for data acquisition. The Contractor may need to operate the device for data collection, and shall submit the data according instructions from EPA WAM or his/her designees.

- Compile water storage tank and pump operation data for both the Cherry Grove site and the entire GCWW network. The data collection include historical >3 years of monitoring data, and location specific process-instrumentation diagrams (PIDs).

Task 2 Engineer and construct the prototype EPA-EWOS for testing according to provided specifications

EPA will develop specifications of the prototype SmartWater system for testing at the GCWW sites. The system, a largely software platform with SCADA communication and control capability, will consist of the modules for Miller plant and Cherry Grove site. The Contractor shall assist EPA in developing the prototype and test-run at the EPA Test and Evaluation (T&E) facility.

In last year's Work Assignment one task was the model and monitoring of water quality in network perimeter of laminar flows. The Contractor shall continue this development and bring the work to an end with developed model and monitoring techniques before December 2014.

Task 3 Perform the site installation and prepare the prototype for testing by April 2015

This task is less defined in scope, because the technical complexity and system components are not developed yet. However, the Contractor may prepare activities in the following general areas and prepare for contingencies as typically for a research and development project. These activities include:

- Design a testing plan and specify site system configurations for EPA-EWOS testing;
- Conduct site testing and data collection for two full months. The system will be run offline from the GCWW' operating systems. Therefore, the Contractor shall work with EPA WACOR and plan for near-real-time data collection to simulate the system performance by 1) energy/chemical consumption in the treatment and distribution; 2) water quality monitoring in various places of the water plant and distribution system, and 3) certification of energy reduction recognized by the Duke Energy's energy saving program.
- Make arrangement for third party's involvement on critical portion of the project. It is more than likely that these involvements will be in short duration. EPA WACOR or his/her designees will issue specific requirements in written technical instructions.

Task 4. Project Management

This work assignment will involve confidential business information (CBI) including patented and proprietary technologies that project participants may have. The Contractor shall follow all contractual requirements on safeguard of the CBI. The Contractor shall demonstrate to EPA the plans on safeguarding relevant CBI that the Contractor will have available to them.

Project Duration

The performance period is from August 1, 2014 to May 30, 2015.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-10

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Tech Support of ESF & East For
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec. 3 #1,2 and 3; Sec 4 #1, 2, 4, and 5

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full title: Technical Support for the Experimental Stream Facility and East Fork Watershed Research

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2015		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Donald Brown	Branch/Mail Code:
(Signature) (Date)	Phone Number: 513-569-7630
	FAX Number:
Project Officer Name: Ruth Corn	Branch/Mail Code:
(Signature) (Date)	Phone Number: 513-569-7920
	FAX Number:
Other Agency Official Name	Branch/Mail Code:
(Signature) (Date)	Phone Number:
	FAX Number:
Contracting Official Name: Matthew Growney	Branch/Mail Code:
(Signature) (Date)	Phone Number: 513-487-2029
	FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract No. EP-C-~~09~~14-012~~041~~
Work Assignment: WA 4~~0~~-10

Title: Technical Support for the Experimental Stream Facility and East Fork Watershed Research

Work Assignment Contracting Officer's Representative (WA COR):

Donald Brown
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Period of Performance: June1st 2014 to May 31st 2015

BACKGROUND

The Experimental Stream Facility (ESF) is a unique research facility located in Milford, Ohio which is located in the watershed of the East Fork of the Little Miami River (EFW). The ESF is leased by the U.S. EPA (EPA) from the Clermont County, Ohio, Water Resources Department. This statement of work covers the ESF and associated field sites in the EFW watershed. EPA requires support for conducting research at the ESF and in the EFW. ~~Specific tasks are outlined below and range from routine sampling and sample processing to the design and implementation of modifications of the experimental infrastructure~~

There is a lack of a working understanding of the linkage among non-point source stressor loads, biotic response, and commonly installed best management practices (BMPs) for stressor abatement in small stream systems. This is true even though: these ecosystems comprise roughly 72% of the river miles in the continental US; current maximum daily load modeling efforts ignore small stream processes altogether; and watershed models treat stressor fate as simple first order reactions when estimating watershed loads with no linkage to in-stream biological effects. A more explicit representation of small stream processes related to biotic responses is needed to inform our understanding of the role these ecosystems play in sustaining small-scale (hundreds of acres) watershed ecology and in reducing downstream non-point source pollutant loads in larger-scale (tens of thousands acres) watersheds. A better understanding will improve TMDL calculations, source water protection, and the subsequent implementation of watershed management strategies.

In the ESF, meso-scale studies in model streams support the development of stressor to biotic response linkages. Experiments focus on the effects of multiple stressors such as, excess sedimentation, loss of canopy cover, metals, nitrogen, phosphorus, fertilizers, pesticides/ herbicides, nanoparticles, antibiotics, and other chemicals, including human and/or animal pharmaceutical and hormonal compounds. It is logistically intractable to apply such an approach in a field setting. The ESF provides the requisite control yet is scalable to the field condition. This, in combination with in-kind parameter measurement and monitoring at field sites, will allow for the development and testing of small channel ecosystem models that can be used as algorithms in watershed management models.

The overall scientific approach to the watershed management research is geared toward elucidating the primary mechanisms of ecological-based aquatic system functional change (carbon and nutrient cycling) as landscapes are altered under new development and are mitigated with hillslope BMPs, stream channel-riparian zone restoration/protection, and other watershed management tools. The outputs are intended to provide water resource managers better tools for TMDL calculations and implementation, BMP effectiveness determinations, and early warning for water quality degradation.

TASK DESCRIPTIONS

To differential between CB&I and other contractors, "CB&I" will be used to specify CB&I, and "other contractors" will be used to specify other non-EPA support. Tasks are divided into two sections: (1) those for which CB&I will have primary responsibility, and will station adequate personnel at ESF to perform the tasks; and (2) tasks for which CB&I will provide intermittent support on an as needed basis, from staff stationed at other Cincinnati locations, when requested by technical directive from the EPA WA-COR.

1) CB&I Primary Tasks

CB&I shall designate an "ESF Manager" to coordinate and oversee all CB&I activities and overall operation of the ESF systems in support of research objectives. This includes taking primary responsibility of ESF experimental fail-safe warning protocols, including being the primary contact and responder when the ESF sends an alarm. The ESF Manager will be responsible for data management for data collected/generated during experimentation, and activities required to maintain compliance with the ESF NPDES permit. CB&I's choice of ESF Manager must be approved by the WA COR.

CB&I shall perform all tasks in accordance with the "ESF O&M Manual" (2005); the "Quality Management Plan And Baseline Quality Assurance Project Plan: Experimental Stream Facility And East Fork Watershed Study: Research Linking Land Use Management Practices To Ecologic Structure And Function In Small Stream Ecosystems" (QAPP) (2006); the Health and Safety Plan (HASP 2011-036 Rev 8) (2014); and ESF Standard Operating Procedures (SOP) which have been created and revised over the life of the ESF. All documents have been provided to CB&I by EPA. Any changes to these procedures will be specified in amendments to the QAPP, HASP, SOPs, or technical directives from the WA COR.

1a) Base Support for ESF - The ESF is a complex and highly integrated experimental facility with a computer control and data acquisition system, that can be used for simulating stream ecosystems, controlling forcing functions of interest, monitoring water physical, chemical and biological properties, and acquiring and storing data. Experiments can run continuously from approximately March through November, and CB&I has the primary responsibility to keep the experimental infrastructure running. CB&I has the primary role for operation and maintenance (O&M) of all aspects of the ESF infrastructure and control systems, such as: water delivery and discharge; experimental lighting; water monitoring sensors and associated equipment; computer software/hardware control system, data acquisition and archiving, and data management; reporting for the NPDES permit; OSHA confined space entry as required for routine O&M; and other tasks required for the operation and maintenance of the ESF. This task may require CB&I to occasionally respond to issues that occur outside of normal business hours. The ESF Manager will be the primary responder, and CB&I will establish a plan to train and provide alternate primary responders when the ESF Manager is unavailable. CB&I's response plan and proposed alternate responders must be approved by the WA COR.

1b) Continuously Monitored Parameters - CB&I will be primarily responsible for continuously monitored parameters (e.g. water quality, meteorology, light, and flow) and resulting data. On-site CB&I personnel shall be familiar with continuous monitoring instrumentation, calibration, and maintenance; data acquisition and management protocols and computer software. CB&I will be responsible for discharge monitoring and tracer studies, and will be familiar with analytical equipment such as GC to conduct these studies. Experimental parameters may be added or changed from time to time and changes will be defined in technical directives from the WA COR. For continuously generated data, CB&I will perform a cursory review of the data at least weekly to look for indicators of malfunctioning sensors or other problems with data generation and acquisition.

1c) Data Management - A large quantity and variety of data is generated at both the ESF and EFW field sites, and CB&I has primary responsibility for managing all this data. Management of the data associated with the ESF and field sites is a significant task, requiring familiarity or a willingness-to-learn about all aspects of the data, including: a) how the data is generated; b) characteristics of the data so that out of range or suspecting values can be flagged; c) database software; d) practices for managing data; and e) basic programming skills. The ESF computer control room houses computer hardware and software for controlling, acquiring, archiving, transferring, and viewing the various data streams. Data acquisition, quality, and management will be done in accordance with the QAPP and SOPs, as modified by technical directives. The task requires a working familiarity with ESF computer control software as this is integrated with data acquisition and management, fail-safe alarms, and infrastructure maintenance. CB&I will operate and maintain the supporting computer hardware and software for the data entry, storage, and acquisition, including routine backing up of all data and operating software. Maintain local connectivity to the ESF operating system and data storage computers. CB&I will provide support to the effort to build a database structure capable of warehousing and managing the large quantity and variety of data generated. The database structure will include user-friendly input and output screens for data entry and acquisition, including export to standard spreadsheet, statistical analysis, and modeling software. The database structure should be adaptable for use by a wider audience within NRMRL-Cincinnati researchers for their individual research projects.

1d) Protection of ESF and EFW Data - CB&I will provide the WA COR with a written plan for routine backup of all ESF and EFW data, including backup to an off-site location at least

monthly. CB&I will perform these backup procedures as described in the plan. At such time as ESF may be connected to the LABLAN, the plan will be reviewed as revised as needed.

1e) East Fork Watershed Modeling - GIS-based software is used to help integrate and manage geographical data related to watershed characteristics in the landscapes drained by the field stream sites. CB&I will support GIS-software-related manipulations for field site catchment characterizations. CB&I shall provide personnel competent with geodata acquisition, geodatabase creation and management, and GIS spatial analysis and mapping software. Hydrological models of varying complexity are often used to characterize land use impacts. These models are parameterized from data compiled in the GIS, and from other sources. CB&I shall provide personnel competent in modeling the hydrological cycle using common modeling software such as EPA's SWMM (StormWater Management Model), and USDA's AGNPS (AGricultural Non-Point Source Pollution Model).

1f) Replacement of ESF's System Control and Data Acquisition System – The ESF has a computer system that controls operations at the ESF (control of flow rates, daily light cycles, pumping of chemical doses, simulation of storm events, etc). The system also records all data generated by ESF sensors (e.g. light output readings, six water quality parameters at nine locations, and both indoor and outdoor climate conditions). The company which made the existing system no longer exists, and support or upgrades to the system are not available. While SCADA systems used in other applications are common, the new system for ESF must be selected and configured to meet the unique needs of the facility. CB&I, as the entity responsible for ESF operations, and thus the most familiar with the current system, will implement all aspects of the replacement including selection, acquisition, installation, customization, and testing. The installation will occur after this summer's experimental period ends because operations at the facility must be shut down to implement the replacement. The new system must be operational and tested prior to April 15, 2015. CB&I will obtain written approval from the WA COR at each step in the replacement process before proceeding: after selection and prior to acquisition; after acquisition and prior to installation; and after installation and prior customization and testing. CB&I will provide detailed updates to the WA COR during all phases of the replacement.

2) CB&I Intermittent Support Tasks

2a) EFW Field Site Support - Ten to twenty field sites in the EFW watershed have sampling and monitoring infrastructure such as water quality sensors, flow meters, metrological sensors, and in-stream sampling devices. EPA staff and other contractors have the primary responsibility for field activities, but CB&I support may be required where EPA staff do not have the appropriate expertise (e.g. electrical work, trouble-shooting instrumentation). CB&I shall provide technical support at EFW field sites on an as needed basis, when requested by specific technical directive.

2b) Modifications to Experimental Infrastructure - When experiments are not being conducted, the ESF infrastructure must still be maintained, and modifications and repairs to the infrastructure to meet additional or new research objectives are done at this time, by EPA and other contractors, with support from CB&I, as defined by technical directives from the WA COR. CB&I shall provide intermittent support as requested by technical directives regarding modifications to the ESF infastructure. This support may include engineering planning and design, repair, purchase, construction, and installation of modifications to the experimental

infrastructure. This support may require skills such as, electricians, plumbers, craftsman, OSHA-trained confined space entry and rescue personnel, health and safety officers, machinists, and engineers.

2c) Experimental Support - EPA staff and other contractors will have the primary responsibility for managing and carrying out research experiments at ESF and EFW field sites. However, CB&I support for general sample collection and sample analysis tasks may be needed during periods of peak activity. CB&I support will be initiated by technical directives from the WA COR on a limited basis as needed during peak activity. EPA researchers not directly associated with the ESF and outside collaborators may use the ESF and/or EFW field sites from time to time to conduct experiments. CB&I support of these activities will be specified in technical directives from the WA COR.

TECHNICAL DIRECTION

Technical direction will be provided in the form of emails from the EPA WA COR to the CB&I ESF Manager. As Principal Investigator, the EPA Alternate WA COR is also authorized to provide technical direction via email to the CB&I ESF Manager, with copy to the WA COR. All technical directions will copied to the CL-COR and Contracting Officer via email.

SCHEDULE AND DELIVERABLES

CB&I will provide monthly, written reports describing past activities, problems, resolution, budget, use of intermittent personnel, and future activities. Email is an acceptable method of communicating reports.

CB&I will provide details of their acquisition process prior to purchase of the SCADA upgrade.

CB&I will provide a plan for responding during non-business hours.

CBI will provide a data back-up plan.

Data collected/generated by CB&I will be entered into Excel spreadsheets and/or MySQL data tables that are created in accordance with the QAPP, SOPS, or technical directives from the WA COR. For data collected on paper logs, at least ten percent of entered data will be checked against the raw data sheet for accuracy of entry. All data will be perused for missing values, outliers and reasonableness, and missing and questionable data will be flagged in the spreadsheet of data table. All data collected/generated by CB&I will be entered no later than 2 months after it is collected/generated. CB&I will incorporate data collected/generated by EPA staff and other contractors and delivered to CB&I in Excel spreadsheets and/or MySQL data tables, into the ESF data base.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-10

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2019	
	Base X Option Period Number	

Contractor: CB&I FEDERAL SERVICES LLC

Specify Section and paragraph of Contract SOW:

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 06/01/2014 To 05/31/2019		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Donald Brown (Signature) (Date)		Branch/Mail Code: Phone Number: 513-569-7630 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)		Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)		Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Matthew Growney (Signature) (Date)		Branch/Mail Code: Phone Number: 513-487-2029 FAX Number: 513-487-2109

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-11

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015 Base X Option Period Number	Water Reuse and Soil Column St

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	3.0 Research Support #1, #2, #3, #4

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 10/27/2014 To 05/31/2015

Comments:
Full Title: Technical Support to the Water Reuse and Soil Column Studies

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2015		0
This Action:		2,772
Total:		2,772

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Jill Neal (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7277 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT

Contract No. EP-C-14-012

Work Assignment 0-11

I. Title: Technical Support to the Water Reuse and Soil Column Studies

II. FedConnect/EAS Title: Water Reuse and Soil Column Studies

III. Contract Officer Representative:

Jill Neal
Urban Watershed Management Branch
Water Supply and Water Resources Division
U.S. EPA National Risk Management Research Laboratory
Cincinnati, Ohio 45268
Phone: 513-569-7277

Alternate Contract Officer Representative:

Dr. Y. Jeffrey Yang
Urban Watershed Management Branch
Water Supply and Water Resources Division
U.S. EPA National Risk Management Research Laboratory
Cincinnati, Ohio 45268
Phone: 513-569-7655

Project Officer:

Ruth Corn
Acquisition Specialist
COR to the T&E Contract, EP-C-09-041
Cincinnati SEE Site Coordinator
U.S. EPA, ORD, OARS, EMD, CB
26 W. Martin Luther King Drive
MS- WG12
Cincinnati, OH 45268
513-569-7920

Period of Performance: October 27, 2014 to May 31, 2015

IV. BACKGROUND:

The project "Water Reuse and Aquifer Storage and Recovery (ASR) Soil Column Studies" is a formal part of the Safe and Sustainable Water Resources (SSWR) Project 5.6 and 2.4. One focus area is the study of above-ground water treatment/conditioning in control of arsenic, pesticide, and other pollutant in water reuse and ASR practices. The intended outcome is EPA guidance on ASR operations and models for assessing and evaluation of contaminants in U.S. drinking water sources.

Specifically, technical services are required under this Work Assignment to support EPA's effort to complete the ASR model and operational software. These tools and methods are to enable water utilities with information and tools for their development and management of ASR. This statement of work pertains to the continuation of the technical support of the previous contract year and for the contractor to furnish the full development.

V. TECHNICAL SUPPORT:

For this requirement the contractor shall review the status of past ASR model and software development, and address the technical incompleteness for an operational and functional ASR package. The contractor shall work closely with the EPA Work Assignment Manager Contract Officer Representative (EPA WA COR) or her designee in completing and finalizing the ASR package. At the request by technical direction of EPA, the contractor may need to design and perform additional experimental studies for the model development and software evaluation before release.

Task 1 Fully Develop ASR Operational Model and Software

Based upon the previous Option Year 4 work, the contractor shall provide all necessary technical support to address the technical weakness in ASR model and software:

1) Incorporate into the software the process of arsenic remobilization from soil into injectants and groundwater. These models should be based on the past ASR experimental results and/or supplemented by those in literature;

2) Incorporate the model and software ability to adjust ASR injectant chemistry for changes in groundwater and thus arsenic remobilization.

Depending on the needs for contingent experimental testing, the contractor shall provide support in acquiring additional testing, and other necessary analytical testing and related technical support. In this case, Contractor shall follow the technical directions of the EPA WA COR or her designee in testing plan development and implementation.

Task 2 Project management and reporting

The contractor shall:

- Follow all procedures as identified in the EPA approved Standard Operating Procedures for any experimental testing and analysis.

- Provide technical support in the set-up, troubleshooting, and maintenance of the water reuse and soil columns as identified within this statement of work and/or as directed through written technical direction provided by the EPA WA COR.

- Maintain an effective communication with EPA on testing station maintenance, as well as support to on-site EPA project personnel.

- Follow the EPA-approved QAPP to complement EPA research tasks conducted at the EPA Test and Evaluation Facility or at contractor's own research facilities.

- Revise or amend as necessary the Quality Assurance Project Plan (QAPP) for specific experimental work plans on a series of experimental testing per technical direction provided by the EPA WA COR.

- Project progress, results and highlights shall be summarized based on research findings. The contractor shall provide a Draft Summary Report and the ASR software on or before May 10, 2015.

- After addressing the EPA WA COR's comments, the contractor shall provide a Draft Summary Report and the ASR software by May 31, 2015.

VI. Monthly Reports and Meetings

A. Monthly Reports

Monthly reports summarizing the status of the Work Assignment shall be completed and provided to the EPA WA COR as part of the Work Assignment deliverables. The monthly reports shall:

- Summarize the work accomplished and milestones and deliverables achieved under all the individual tasks,

- Itemize and track separately the budgets and level of efforts for the tasks.

- Summarize the planned activities anticipated for the upcoming period,

- Identify problems encountered and resolutions,

B. Project Support Maintenance Meetings

Project meetings shall be conducted as needed to assure the completion of the project tasks as proposed and approved. The contractor shall provide at a minimum the following

information: planned project activities for the upcoming reporting period, problems encountered and resolutions and budget information.

The contractor shall provide the EPA WA COR all project management information in hard copy and electronic format. The contractor shall summarize project meetings and submit to the EPA WA COR in the most up-to-date version of Microsoft Word format within five (5) working days of the project and research collaboration meetings. Summary of the meetings shall be provided to the EPA via E-mail.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-12

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015 Base X Option Period Number	SWMM-SWAT GI Modeling GAP Anal

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	3. 0 #1 and #3

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 10/01/2014 To 05/31/2015

Comments:
Full title: Technical Support for SWMM-SWAT GI Modeling GAP Analysis

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Contract Period:	Cost/Fee:	LOE:
	06/01/2014 To 05/31/2015		0
This Action:			3,165
Total:			3,165

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee:	LOE:
Cumulative Approved:	Cost/Fee:	LOE:

Work Assignment Manager Name: Christopher Nietch	(Signature)	(Date)	Branch/Mail Code: Phone Number: 513-569-7460 FAX Number:
Project Officer Name: Ruth Corn	(Signature)	(Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name	(Signature)	(Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley	(Signature)	(Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT EPA Contract No. EP-C-14-012
Work Assignment: WA-0-12

TITLE: TECHNICAL SUPPORT FOR SWMM-SWAT GI MODELING GAP ANALYSIS

EAS Title: SWMM-SWAT GI Modeling GAP Analysis

Work Assignment Contracting Officer's Representative (WA COR):
Christopher Nietch
U.S. Environmental Protection Agency
National Risk Management Research Laboratory
Cincinnati, OH 45268
Phone: office 513-569-7460; stream lab 513-965-4805; mobile 513-317-9394
Email: nietch.christopher@epa.gov

Alternate WA COR:
Mehran Niazi
U.S. Environmental Protection Agency
National Risk Management Research Laboratory
Cincinnati, OH 45268
Phone: office 513-569-7332
Email: niazi.mehran@epa.gov

Period of Performance: October 1, 2014 to May 31, 2015

EPA INVESTIGATORS TEAM: Ashley Allen, OW, OST; Chris Nietch, ORD, NRMRL; Mehran Niazi, ORD, NRMRL; Heather Golden, ORD, NERL; Mohammad Hantush, ORD, NRMRL; Roy Martin, ORD, NERL; Bob McKane, ORD NHEERL; Yusuf Mohammad, ORD, NERL; Brenda Rashleigh, ORD, NHEERL; Lew Rossman, EPA Emeritus Consultant; and Michael Tryby, ORD, NRMRL

BACKGROUND: This work assignment calls for modeling work that will serve as foundation for research of broader scope that EPA is planning for the FY16 to FY20 timeframe within the Safe and Sustainable Water Resources (SSWR) National Research Program. EPA ultimately desires a set of modeling approaches and model enhancements that will be used to quantitatively estimate the impacts that natural and engineered Green Infrastructure (GI) used for stormwater management have on water quantity and quality at different watershed scales: lot- and street-level parcels; headwatersheds to small watersheds (HUC 12 - 10); and regional basins (HUC 8- 4).

Note, that this PWS describes the full project and the tasks/steps that EPA thinks are required to complete the project objectives. EPA anticipates that outlined level of effort will require one full calendar year. However, the period of performance for the WA is approximately 8 months. Hence, the specific deliverables expected by the end of May, 2014 have been delineated below. Subsequent work

is also included for informational purposes and to maintain the integrity of the logic flow outlined for the project in these introductory sections.

Two models are under evaluation in this work. The Stormwater Management Model (SWMM) which EPA maintains, and the USDA's Soil Water Assessment Tool (SWAT), which the EPA's Office of Water has invested heavily. Both of these models are commonly used to model urban and agricultural watersheds, respectively. The SWMM model's strength is in urban drainage engineering design. It can be used within a continuous or event-based framework. SWAT is used frequently to simulate the effects of land uses, cropping system management operations, and land use change on larger watershed hydrologic and nutrient loadings. It is often applied in mixed-use watersheds, but its urban modeling modules are not as well developed compared to SWMM, and its output is geared toward monthly to annual timeframes for analysis. Neither of these models can be used in their present form to simulate urban GI for both water quantity and quality at any scale. EPA requires a better understanding of the potential of these state-of-the practice models for simulation of GI for both hydrology and water quality, nutrient species, in particular. Potential also exists to integrate other watershed models in this evaluation that have recently-added GI capabilities (e.g., the VELMA model) for additional comparisons.

The work described below is staged to conduct two types of gap analyses with the SWMM and SWAT modeling packages, as we try to use or enhance them to model GI at the scale for engineering design and implementation (i.e. for MS4s), and scale the local GI performance to a larger watershed outlet for load reduction estimation and source allocation among all sources (i.e., cropping system loadings, point sources, septics, CSO, and MS4s). The primary users of this research will be MS4 permit holders and their consulting agents, Community and Regional Planning Authorities and State Program staff involved in 303 TMDL development. EPA's Office of Water also seeks tools to evaluate GI contribution to stormwater management in urban dominated watersheds and understand GI's role in reduction to CSOs, MS4s and SSOs.

SCOPE: Two tasks shall be conducted in parallel. The first calls for a SWMM model gap analysis and includes a case-study GI/LID-specific modeling to be implemented in SWMM (note, the term LID, for low impact development, is used somewhat synonymously with GI here because SWMM has existing LID modeling capacity that shall be evaluated in the gap analysis). The second task takes advantage of existing model implementations in the East Fork Watershed, and also using a case-study approach, shall explore methods for scaling GI effects from the lot to HUC 12 watershed scale. SWMM and SWAT shall be used together to model GI/LID at larger watershed scales in the second task. This second task may also involve applying SWMM with an additional watershed model (e.g., the VELMA model) that represents GI hydrological and biogeochemical processes differently than SWAT. This would be conducted to provide uncertainty bounds and potential validation for the SWMM-SWAT watershed scale analysis.

The work requires experience handling and processing the raw physiogeographic, chemical, and hydrological data from the well-studied areas to complete the necessary parameterization, calibration and/or validation of the models. EPA shall provide the raw data directly or a specific contact for acquiring the needed information. Demonstrated experience in implementing SWMM, SWAT or both in watersheds is required to complete different aspects of the work described below. Other models/modeling experience may be brought to bear to complete tasks effectively. Additionally, a process-based water

quality model development capability shall be required to complete the LID modeling subtask. Experience conducting formal model uncertainty analysis shall be required, including sensitivity analysis, calibration, and validation model evaluation methods.

Overarching **question** for this work assignment: What are the workflow, information, and conceptual gaps hindering the utility of SWMM and SWAT tools for modeling GI at both local and watershed scales?

APPROACH: Use extant data from two well-studied and monitored areas to develop the GI modeling potential in SWMM for water quality and scale catchment GI performance to a larger watershed (HUC 12). The later will be attempted in this specific work assignment using SWAT. We will not try to physically link the two models, rather use output from SWMM as time series input to SWAT, to begin to understand the conceptual, information, and workflow inconsistencies that may exist in the spatial scaling of GI performance. The well-studied areas include the St. Francis Rain Garden Catchment (11 acres) to Lick Run subwatershed (2700 acres) to the Lower Mill Creek Watershed (30,232 acres, HUC12). The focus of the first task is on the St. Francis catchment. For the second task the Shayler Crossing Headwatershed (233 acres) to Shayler Run Confluence (7929 acres, HUC 14) to Salt Run - East Fork Little Miami River Watershed (27,196 acres, HUC12) shall be considered. This nested watersheds scheme has been monitored by ORD since 2006 and both SWMM and SWAT models have been implemented that can be used to help conduct the work called for here.

TASK SCHEDULE

Task 1. SWMM Model Gap Analysis and LID Modeling

Task Background

Across the nation, there is increasing interest in Low Impact Development (LID) as a means of reducing urban runoff and associated pollutant loads to receiving waters, amongst water utilities, National Pollutant Discharge Elimination System (NPDES) permit holders, and city, state, and federal government agencies. To support these endeavors, several hydrologic and hydraulic models have been developed. EPA's Storm Water Management Model (SWMM) is a widely used tool throughout the world for planning, analysis and design of stormwater management systems including combined and sanitary sewer systems, and runoff reduction practices using low impact developments (LIDs) and best management practices (BMPs). However, water quality simulation in SWMM and in particular the fate of pollutants in LIDs is overly simplistic in representation of the physical, chemical, and biological processes that result in the reduction or removal of dissolved and particle bound pollutants. One of the main mechanisms in load reduction in certain types of LIDs and BMPs such as retention, bio-retention ponds, rain gardens, constructed wetlands and sand filter is settling of suspended particles which effectively removes particle associated contaminants but does not significantly affect dissolved constituents. This distinction has not been incorporated into SWMM. Furthermore, one of the challenges in using watershed-scale models such as SWMM in evaluating the effects of LIDs on the overall water quality is that the large number and variations in the configuration of LID practices, particularly the ones applied at lot scale (e.g. green roofs, rain gardens, rainwater harvesting) is extremely challenging to characterize and implement in models with an adequate level of detail (Krebs *et al.*, 2014).

Consequently, a homogenized representation of such LIDs at the sub-basin scale is typically considered instead (Qin *et al.*, 2013; Walsh *et al.*, 2014). Ultimately it is important to quantify the uncertainty associated with model predictions including model structural uncertainty due to the simplified representation of the processes, parameter uncertainty and uncertainty due to up-scaling or homogenization at the sub-catchment scale. To improve the water quality simulation in SWMM there is a need to investigate: a) process-based detail modeling of LID for flow and water quality at the lot scale, b) governing fate and transport mechanisms in LIDs and c) up-scaling, model reduction, feasibility with finding the optimal values of "effective" parameters used in SWMM in order to result in predictions as close as possible to the LID model.

Reviews of SWMM applications and/or fate and transport algorithms have been previously reported, occasionally in conjunction with comparisons with other models (e.g., Obropta and Kardos, 2007; Borah and Bera, 2003, 2004). However, these prior reviews do not offer an inclusive gap analysis of the complete body of SWMM applications and the fate and transport algorithms that have been reported in the peer-reviewed literature. There is a need to fill this gap by providing a review of the full range of studies that have been conducted with SWMM and to highlight emerging application trends. Thus, the specific objectives of this gap analysis are to: (1) provide an overview of SWMM development history, including the development of flow and water quality component tools and examples of modified SWMM models; (2) summarize research methods for the many of the more than 150 peer-reviewed articles that have been identified in the literature, as a function of different application categories; and (3) describe key strengths and weaknesses of the model and list a summary of future research needs.

Task1A: Case study of LID modeling:

Objective 1: Develop a comprehensive stand-alone LID/GI (detailed rain garden) model:

- Water balance considering interflow and infiltration via Richard's Equation.
- Coupled mass balance for dissolved constituents, sorbed constituents and suspended particles.

In this performance period the contractor shall investigate the St. Francis Apartment rain gardens (LID representative) in the Lick Run Watershed as the case study. In this research the contractor shall simulate flow and water quality parameters on total and dissolved nutrients (including dissolved reactive phosphate, dissolved ammonia, dissolved nitrate-nitrite, total phosphorus, and total nitrogen) and total and dissolved organic carbon (TOC and DOC) under both monthly (dry) and storm event conditions using a process-based detail model that will be developed. For flow, the model shall consider water balance as a result of inflow and outflows as well as infiltration or interflow. The infiltration shall be modeled using Richard's equation explicitly considering soil water retention characteristics. For water quality the model will consider physical, chemical and biological processes governing the fate and transport of both dissolved and particle bound nutrients in the rain garden system. These processes include sedimentation of suspended solids and sorbing contaminants associated with them, contaminant mass-exchange between particulate and aqueous phases, mass transfer between

overlying water and the bottom soil layer, infiltration and percolation of water and dissolved contaminants. The parameter uncertainty will be assessed using a backward uncertainty propagation algorithm such as Bayesian inference and the range and uncertainty of the parameters will be evaluated using the available data on both water quantity and quality.

The contractor shall comply with the QA requirements of EPA-ORD-NRMRL. The contractor shall provide QA Project within 30 days from the work assignment issuance detailing the work needed under this task. The QAPP should include reference to the documentation of the code to be developed for the LID model. The code documentation shall be in sufficient details to allow seamless application of the model in a stand-alone mode. The QAPP will be reviewed by EPA Quality Assurance Manager and, if necessary, will be revised by the contractor.

Consulting with the WA COR and Alt COR, the contractor shall develop a mechanistic rain garden flow and transport model. The model will be comprised of modules representing the processes in the ponded water and underlying soil and shall allow the system to be divided into multiple compartments (see figure 1). The relationships between the flows from each compartment to the adjacent one shall be specified as user-defined relationships based on the hydraulic head difference between the two compartments. The model shall be able to consider the processes affecting the fate and transport of contaminants in an adequate level of detail. These processes include transport of dissolved, particulate constituents and the interaction between them due to sorption and desorption, settling, infiltration and biotransformation. A deterministic and a probabilistic parameter estimation framework shall be developed to estimate the model parameters based on the collected data in a holistic way. This means that one set of parameters will be determined that can best represent the data including flow, all the water quality constituents during all events. The modeling framework shall be developed in such a way that each parameter can be considered known (fixed) or be estimated. The prior information for each model parameter based on literature values or independent experiments shall be considered in the parameter estimation. An objective approach shall be used to give weight to each of the measured constituents.

Deliverable:
In this performance period the contractor shall prepare a report describing the development of the process-based stand-alone model, capable of simulating stormwater flow and water quality for the St. Francis Apartment rain gardens and a stand-alone LID/GI (detailed rain garden) model that includes: 1) water balance considering interflow and infiltration via Richard's Equation and 2) coupled mass balance for dissolved constituents, sorbed constituents and suspended particles.

***The steps involved in model evaluation and associated uncertainty analysis, described above shall be outlined in the deliverable, but are not expected to be completed by the end of the current period of performance.**

Task1B: Gap analysis on SWMM model application and LID algorithm

Objective 2: Perform a gap analysis on SWMM model application and mathematical algorithm on LID by taking the following steps:

- Model application (type of case studies, tier of complexity of case study, manual development).
- Model development (algorithm, code verification, and temporal and spatial capabilities).
- Model evaluation (sensitivity analysis and uncertainty analysis).

The contractor shall assist the leading EPA scientist on the subject matter, Alt. WA COR, to review, classify, and analyze all the published peer-reviewed papers in wide range of journals on SWMM model application, development and evaluation to summarize research findings for the many of the more than 150 peer - reviewed articles that have been identified in the literature, as a function of different application categories. The papers, provided by EPA, will be classified a priori based on whether the SWMM application has focused on water quantity or quality, whether the model has been used to assess the impacts of future land-use or climate changes or the future LID implementation plans, the approaches used for model calibration, the spatial resolutions of the models and the ways LIDs have been represented.

Furthermore the contractor will investigate the SWMM model's governing equations on water quality and LIDs and identify their strengths and applicability to the various kinds of water quality stormwater simulation. Special attention will be given to the issue of up-scaling and sub-basin scale homogenization. Consulting with the WA COR and Alt COR, the contractor will investigate on the gap analysis of SWMM model application and algorithm development with reviewing and analyzing all peer-reviewed papers focusing on hydrologic and hydraulic assessment of base flow and stormwater flow, water quality assessment for dissolved and soluble constituents, various approaches used for characterization of study area (GIS layers, LIDAR images, soil types, drainage area and sub-catchment characterization), spatial resolutions considered, different approaches for implementing low impact development (rain garden, retention basin, permeable pavement, green roofs, street planters, rain barrels and infiltration tranches), and calibration and validation methods used in each study. Special attention will be given to identifying the potential deficiencies in LID features of the model and proposed approaches in improving the representation of those processes.

Deliverable:

In this period of performance the contractor shall assist the Alt. WA COR with the preparation of the SWMM gap analysis report.

Timeline for Task 1

Tasks		6 months	12 months
Gap Analysis	SWMM Application	√	
	LID Algorithm		√
Rain garden modeling			√

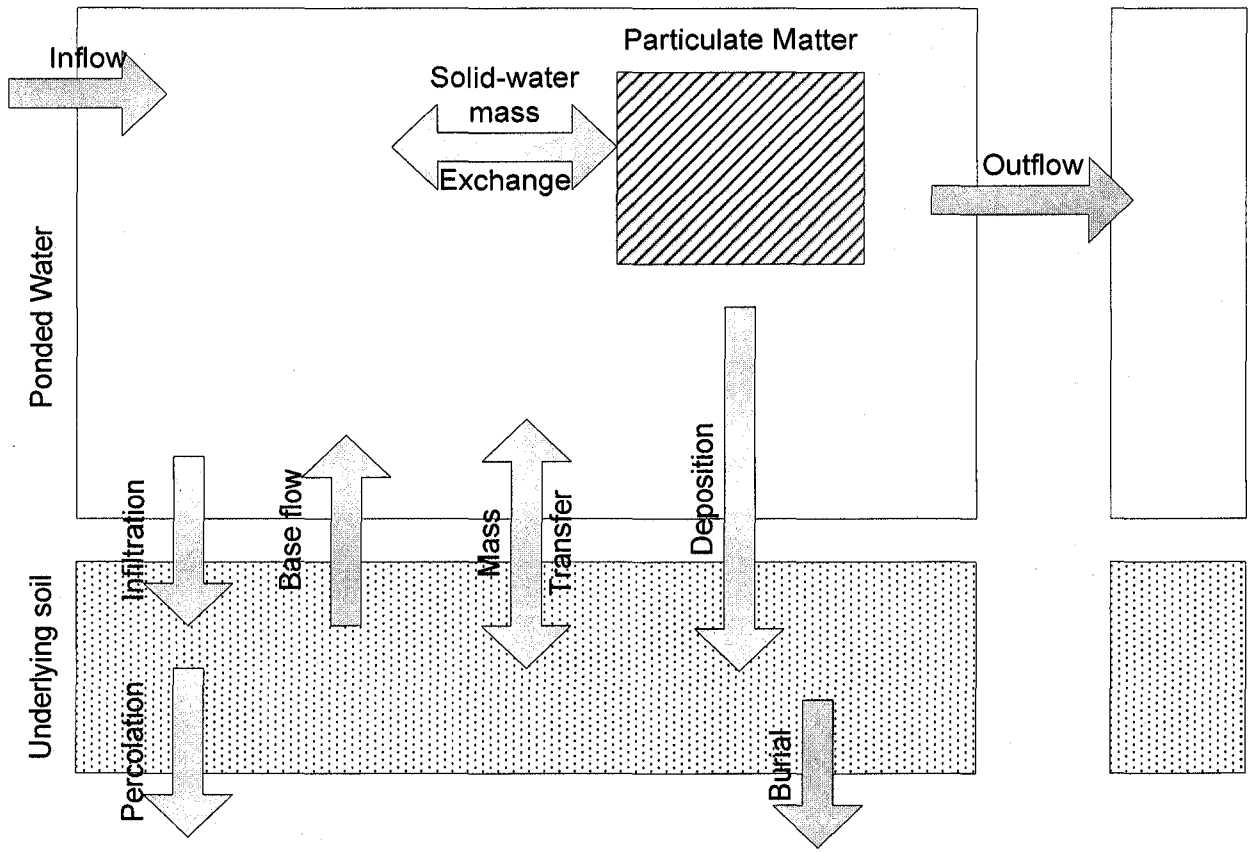

Figure 1; Schematic of mass balance for flow and water quality constituents

Task 2: Preliminary modeling assessment of GI performance at watershed scale.

Objective 3: Compare two, single-type, GI performance scale-up modeling approaches at the HUC12 watershed level using current SWMM and SWAT modeling packages in the East Fork Watershed: Determining MS4 stormwater design criteria impact on receiving water loadings at HUC12 scale.

This task calls for a case study approach using the well monitored, nested watershed scheme, in the urban areas of the Lower East Fork Watershed (figure 2). The task could be considered a SWAT gap analysis for considering SWMM output at a larger HUC 12 scale. But, to be clear, EPA does not anticipate a need to develop new algorithm for SWMM or SWAT to meet this objective. Rather, the intent is to evaluate how the current state of both models can be used to evaluate a specific type of GI performance (bioinfiltration) at a larger, HUC12, watershed scale. The task is staged to help assess the unintended consequences that were encountered by adapting an existing SWAT module, "prairie pot-hole", developed by Jeff Arnold to simulate urban stormwater infiltration criteria in an OW/OST project.

The contractor shall evaluate the existing urban GI infiltration algorithm developed for SWAT at the lot and headwatershed scale in Shayler Crossing and compare it to the algorithm and simulation results obtained when the same processes are modeled with SWMM. Next, the contractor shall research and apply a scaling methodology for MS4 design criteria using bioinfiltration to try to understand the impact of stormwater management on nutrient loading at the HUC12 watershed scale. Since there is no 'standard' approach for accomplishing this, the contractor shall first conduct a literature review and report on the variety of methodologies that have been considered. Next, in consultation with the EPA modeling team one or two approaches for scaling shall be decided upon and applied in the Shayler Run subwatershed and then the Salt Run – HUC 12. An additional model, such as VELMA, that represents GI implementation differently than SWMM and SWAT at the watershed scale may also be included in this analysis. Before attempting the GI performance scaling exercise the Shayler Crossing, and Shayler Run SWAT models shall be calibrated and validated for flow, sediments, and nutrient loads using the EPA's monitoring data.

Then, the SWMM GI modeling results shall be insert into SWAT to synchronize the model. The prairie pot-hole infiltration modules and associated urban land use discharges shall be turned off in this scenario, instead the headwatershed output of SWMM will be integrated into the larger scale SWAT model as a "point source" loading file. In consultation with the EPA modeling team the contractor shall configure a means of applying the shayler crossing SWMM headwatershed model output for all similar urban and suburban headwatersheds of the Salt Run HUC 12 in the Lower East Fork Watershed. Finally, the contractor shall document necessary adjustments for the parameterization of both models and at all the scales studied and discuss in a report the positives and negatives encountered during the modeling exercises. EPA envisions a demonstration product as the result of this exercise that shall identify gaps existing in the current state-of-the practice models for simulating GI at larger spatial scales. The demonstration will define the needs that EPA has to address in future tool development so that stormwater management design for the MS4s can be considered within a larger watershed context for 303 TMDL-type load allocation assessments at a larger than HUC 12 scale (HUC 10 or smaller)

Task 2 Steps and Scheduling

1. The contractor shall evaluate and apply the OW/OST infiltration module developed for the 20 watershed study for the Shayler Crossing subwatershed in the existing Lower East Fork Watershed SWAT model (1 month after WA award).
2. The contractor shall update the current SWMM model developed for the Shayler Crossing headwatershed (233 ac) (Bennet et al 2006) to SWMM-LID, considering the existing BMPs as bioinfiltration retrofits for hydrology and nutrient species, applying a 90th percentile storm capture rule (1 month after 1).
3. The contractor shall compare and contrast each model's performance relative to calibration data for Shayler Crossing stream (raw data supplied by EPA), (1 month after 2).
4. The SWAT model shall be calibrated/validated at the intermediate scale of Shayler Run and the HUC 12 scale. The calibration/validation procedures at each scale shall be used to capture relative uncertainties in the model application and output. The calibration/validation data obtained during the the Lower East Fork Watershed model (ref. WA-17) can serve as the HUC 12 scale uncertainty analysis since the two areas have the same pourpoint (1 month after 3)
5. The contractor shall recommend, and after consultation with the EPA modeling team, implement a scaling methodology for SWAT-infiltration module, first to the Shayler Run subwatershed (7929 ac), then to Salt-Run HUC 12 (27196 ac), applying MS4 design criteria at all scales (1 month after 4).
6. The contractor shall recommend, and after consultation with the EPA modeling team, develop and implement a scaling methodology for SWMM-LID bioinfiltration to the Salt-Run HUC 12 using SWAT model for large scale predictions of MS4 design criteria. The contractor shall insert SWMM headwatershed-scale output as an intermittent point-source input to existing SWAT model to synchronize models (1 month after 5).
7. The contractor shall compare HUC-12-scale nutrient species loading reductions before and after applying MS4 GI design criteria, using the bioinfiltration scale-up methodologies developed for SWMM-SWAT and in relation to agBMP performance prediction and point source loadings using BMP scenarios developed for the SSWR P1.2A water quality trading modeling project (WA-17) (2 months after 6).
8. The contractor shall prepare a written report of the methods and results of the scaling exercises using existing formulations of the SWMM-SWAT models. The report shall include a literature review section of current methods used for scaling GI effects, including efforts underway to model urban GI in SWAT, and a discussion section of the gaps encountered with suggestions for future research (3 months after 7).

Deliverable: **For this performance period the contractor shall prepare a report that includes the results obtained at the end of step 7 above, which includes the modeling methods used and short interpretation of their quality.** A larger document discussing the implications of the results of the GI model comparisons, scaling methods, and the lessons learned; gaps encountered in using the two models to simulate bioinfiltration GI effects at the HUC 12 scale may be considered in a continuation of this effort.

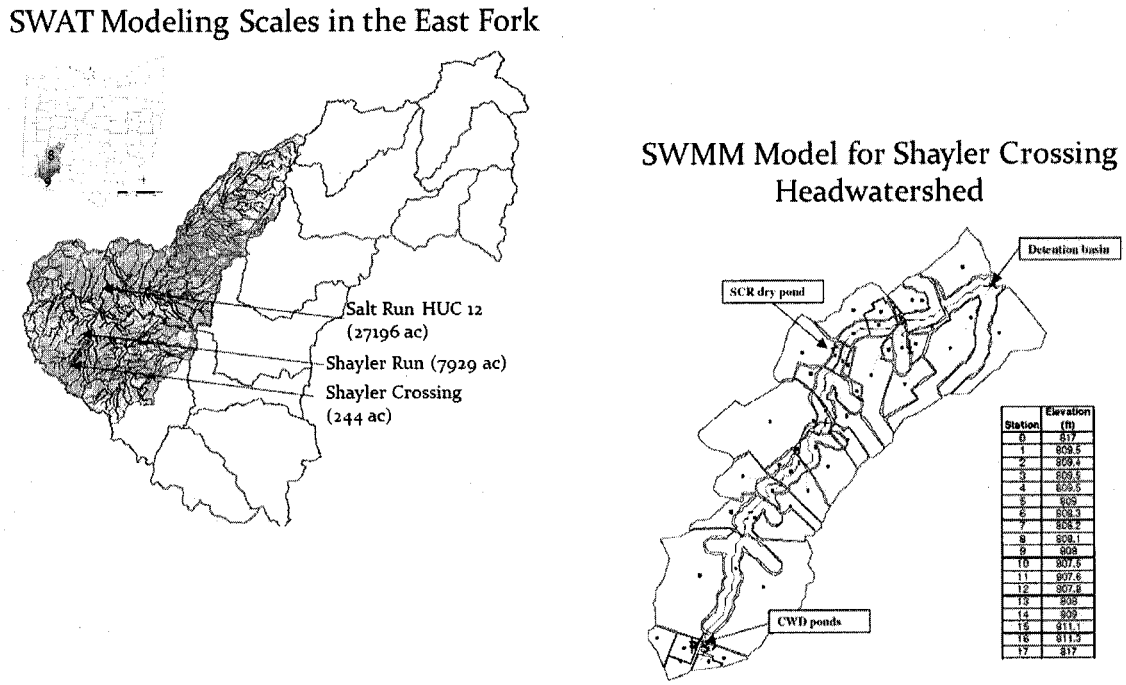

Figure 2. Modeled areas and nested watershed scheme for the East Fork Watershed case study.

ESTIMATED LOE

Task 1: One full-time modeler with experience in process-based hydrological and water quality simulation model development and application. 1 FTE, 1 year

Task 2: One full-time watershed modeler, preferably with both SWMM and SWAT application experience. 1 FTE, 1 year

TECHNICAL DIRECTION

Technical direction will be provided by the WA COR or alt COR in the form of e-mails or meeting minutes. If meeting minutes are written by others, the WA COR will provide e-mail confirmation that direction provided therein is authorized. The WA COR will facilitate access to existing research infrastructure and data specific to the outlined scientific objectives. The Contractor shall be responsible for the final data analyses and write-up of the project's results. The WA COR will provide written review and comments to write-ups delivered at the end of each of the subtasks outlined above. The contractor(s) shall plan to attend and prepare for weekly to biweekly conference calls with the EPA to report on progress. Once a month there will be a conference call/video meeting with the whole EPA modeling team. The contractors shall present progress and expect to have to prepare multi-media briefs.

QUALITY ASSURANCE STATEMENT

The Contractor shall comply with the QA/QC requirements outlined for data management and modeling in the endorsed QAPP (W-16434-QP-1-0/S-11846 [for STD QA tracking]): "Simulation Modeling in Support of Determining the Feasibility of Water Quality Trading in the Upper East Fork Watershed" written by the EPA. The plan covers the minimum requirements for documenting the data quality and methods associated with model development, procedures for model calibration, model sensitivity analysis, and model validation. When necessary for determining data quality for model parameterization, calibration and testing, the Contractor shall comply with the QA/QC requirements outlined in the endorsed QMP/QAPP (634-Q-2-0): "Experimental Stream Facility and East Fork Watershed Study: Research Linking Land Use Management Practices to Ecological Structure and Function in Small Stream Ecosystems" written by the EPA; specifically, the Addendum written by Dr. Nietch that includes 2011 projects. This is an 'umbrella' plan that covers the activities of EPA-PI's, its contractors, and collaborating partners in ESF/EFWS research.

IMPORTANT REFERENCES FOR WORK

Arnold, J. G., Kiniry, J. R., Srinivasan, R., Williams, J. R., Haney, E. B., and Neitsch, S. L. (2011). "Soil and water assessment tool input/output file documentation version 2009." Grassland, Soil and Water Research Laboratory - Agricultural Research Service, Blackland Research Center - Texas AgriLife Research, Texas A&M University System, College Station, TX, 662pp. <http://swat.tamu.edu/media/19754/swat-io-2009.pdf> (June 17, 2013).

Arnold, J. G., Muttiah, R. S., Srinivasan, R., and Allen, P. M. (2000). "Regional estimation of baseflow and groundwater recharge in the Upper Mississippi basin." Journal of Hydrology, 227, 21-40.

Bennett, G., C.T. Nietch, X. Wang, and L. Rossman. 2006. Development of a process-based indicator of land use management for urbanizing headwatersheds. In proceedings: Innovated Environmental Information Systems, 5th International Conference on Environmental Informatics, August 1-3, 2006, Bowling Green, Kentucky, USA.

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Bhaduri, B., Minner, M., Tatalovich, S, and Harbor, J. (2001). Long-term hydrologic impact of urbanization: A tale of two models. J. Water Res. Plan. and Mgmt., 127(1), 13-19.

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Borah, D. K., and M. Bera. 2003. Watershed-scale hydrologic and nonpoint-source pollution models: Review of mathematical bases. *Trans. ASAE* 46(6): 1553-1566.

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Carrubba, L. (2000). "Hydrologic modeling at the watershed scale using NPSM." Journal of the American Water Resources Association, 36(6), 1237-1246.

Cho, J., Vellidis, G., Bosch, D. D., Lowrance, R., and Strickland, T. (2010). "Water quality effects of simulated conservation practice scenarios in the Little River experimental watershed." Journal of Soil and Water Conservation, 65(6), 463-473.

Daggupati, P., Douglas-Mankin, K. R., Sheshukov, A. Y., Barnes, P. L., and Devlin, D. L. (2011). "Field level targeting using SWAT: mapping output from HRUs to fields and assessing limitations of GIS input data." Transactions of the American Society of Agricultural and Biological Engineers, 54(2), 501-514.

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EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-12

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2019	
	Base X Option Period Number	

Contractor: CB&I FEDERAL SERVICES LLC

Specify Section and paragraph of Contract SOW:

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 10/01/2014 To 05/31/2015

Comments:

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
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Authorized Work Assignment Ceiling

Contract Period: 06/01/2014 To 05/31/2019 — Cost/Fee: — LOE:

This Action:

Total:

Work Plan / Cost Estimate Approvals

Contractor WP Dated: — Cost/Fee: — LOE:

Cumulative Approved: — Cost/Fee: — LOE:

Work Assignment Manager Name: Christopher Nietch (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7460 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-14

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015 Base X Option Period Number	Chlorine Inactivation of Anthr

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec 2, par 5; Sec 3

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full Title: Chlorine Inactivation of Anthrax Spores in Decontamination Wash Down Wastewater

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
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Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2015		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Vincente Gallardo (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7176 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
Contract #EP-C-14-012
WA# 0-14

TITLE: Chlorine Inactivation of Anthrax Spores in Decontamination Wash Down Wastewater

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Vicente J. Gallardo
USEPA/ORD/NHSRC
26 W. Martin Luther King Drive
Cincinnati, Ohio 45268
(513) 569-7176 / E-Mail: gallardo.vincente@epa.gov

ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Gene Rice
USEPA/ORD/NHSRC
26 W. Martin Luther King Drive
Cincinnati, Ohio 45268
(513) 569-7204; E-Mail: rice.gene@epa.gov

I. PERIOD OF PERFORMANCE
The period of performance for the tasks detailed in this Performance Work Statement (PWS) shall be from 6/1/2014 to 5/31/2015

II. SUMMARY OF OBJECTIVES
The purpose of this study is to continue the evaluation of the effectiveness of chlorine bleach in inactivating *B. anthracis* Sterne spores and surrogates in wash water generated from various activities. Results showed that chlorine bleach without the addition of vinegar was effective in obtaining a 6 log reduction of *Bacillus globigii* (Bg) spores in various types of wash water. However at colder temperatures and in certain wash water types, the time required to obtain 6 log reduction was long, i.e., greater than 1 and sometimes 2 hours.

It is widely known that the addition of an acid such as vinegar or acetic acid lowers the pH of chlorine bleach and increases the ratio of hypochlorous acid to hypochlorite ions and that the former species is much more germicidal than the latter. At pH = 7, the majority (75%) of the chlorine species is in the hypochlorous acid form. However, the addition of an acid to chlorine bleach solution can pose a safety hazard due to the fact that chlorine gas can form if the pH is lowered excessively. Experience has shown that even the addition of a dilute acid such as vinegar can lower the pH of wash water more than anticipated and to the point where chlorine gas can form. Thus it is desired to evaluate the use of phosphate buffer to lower the pH of bleach/wash water mixtures to specific values within the range of 7 to 9. This allows us to lower the pH in a more controlled manner in order to exploit the germicidal nature of hypochlorous acid and to lessen the potential for chlorine gas formation. The work under this PWS builds on the results generated in Work Assignment #s 1-14 through 4-14, Contract # EP-C-09-041. In this PWS, this previous work will be referred to as work done under WA 14.

In addition, while efficacy of chlorine bleach proved to be effective in inactivating *Bacillus* spores in nearly all wash waters tested, the water generated from an actual cleanup of *B. anthracis* spores would

be different than the washwaters studied in WA 14. Thus in the event of an actual *B. anthracis* event, if generated wash water was treated using the recommendations from WA 14, permission to discharge this treated wash water may still prove difficult since the aforementioned inactivation studies were not site specific, i.e., the studies did not evaluate wash water generated at the site of the *B. anthracis* clean up.

Under this task, a quick and reliable bench scale procedure will be developed to simplify testing of chlorine based inactivation using the actual wash water generated. The goal is to make the procedure easy to conduct while allowing users to produce credible real world data to help on-scene coordinators dispose of treated water at local disposal facilities.

III. TASKS

Task 1. Amend quality assurance project plan (QAPP) and Health and Safety Plan (HASP) developed under Work Assignment 1-14

As necessary, the Contractor shall amend the QAPP and HASP to include the work to be completed under tasks 2 and 3 of this Work Assignment.

Deliverable:
Amended QA plan within 30 days after Work Plan approval
Amended HASP within 30 days after Work Plan approval

Task 2. Carryout inactivation studies of *Bacillus globigii* (Bg) in wash water at different pH values.

The Contractor shall evaluate the use of a buffer such as KH_2PO_4 to lower the pH of chlorine bleach solutions for the inactivation of Bg spores. The specific pH values to be studied are as follows: 7, 8, and 9. In addition bleach/wash water with no pH adjustment shall also be studied for comparison purposes. Under WA 14, both Bg spores and total heterotrophic plate counts (HPC) were measured; under this new work assignment only Bg spores shall be analyzed. If these inactivation studies prove successful, a phosphate fertilizer such as Bonide® Triple Super Phosphate shall be evaluated as an alternative. This type of fertilizer contains a type of phosphate that is chemically similar to KH_2PO_4 and may be easier for on-scene coordinators to acquire.

Deliverable: Results of inactivation studies. The results shall be delivered to the EPA WACOR no later than 5/31/2015. Results shall be submitted in formats compatible with Microsoft Excel and Microsoft Word (Microsoft Office 2007, or later).

Task 3. Development of a quick and reliable bench scale procedure to simplify testing of chlorine based inactivation.

The purpose of the procedure is to simplify testing of the efficacy of chlorine bleach inactivation of *Bacillus* spores. The goal is to make the procedure easy to conduct while allowing users to produce credible real world data.

It is not desired to simplify the recommended method to treat actual wash water but to simplify the way that the efficacy of the recommended method would be tested.

The Contractor shall review the inactivation procedure conducted under WA 14 and described in detail in Muhmammad et al. 2013 and stream line it in in order to minimize effort and difficulty. For example,

some ways to simplify the method may be to specify a lower amount of bleach to allow easier measurement of chlorine or to specify the use of commercially available spore preps to spike the test water. Ideally the procedure would be simple enough so that a technician with 1 - 2 years of microbiological laboratory experience can easily carry it out.

Deliverable: Streamlined bench scale procedure to be delivered no later than 3/31/2015.

Task 4. Report Results.
No later than 30 days following completion of Task 2 and 3, the Contractor shall summarize experimental procedures and project results so as to provide enough information for the EPA to draft an article for a peer-reviewed journal. The procedures and results shall be submitted in formats compatible with Microsoft Excel and Microsoft Word (Microsoft Office 2007, or later). The Contractor shall review the draft article when technically directed to by the WACOR and provide comments as appropriate.

Deliverables:
Summary of data results and experimental procedures within 15 days upon request of the WAM.

V. REPORTING REQUIREMENTS
On a monthly basis for the duration of the project, the Contractor shall submit to the WAM/PO, in electronic format, status reports summarizing technical progress (including estimated percent of project completed), problems encountered, monthly and cumulative financial expenditures and cost and schedule variance.

Deliverable: Monthly progress reports for the duration of the project.

VI. QUALITY ASSURANCE
The awardee shall comply with all requirements as delineated on the "Quality Assurance Planning Requirements Form (QARF)" included with this extramural action. The contractor shall prepare a QAPP in accordance with http://www.epa.gov/quality/qs-docs/r5-final.pdf or based on the type of research that is being conducted. For guidance on preparing a research-specific QAPP, the preparer should refer to the project specific requirements provided in NHSRC's QMP. The QAPP must be approved prior to the start of any laboratory work. Additional information related to QA requirements can be found at www.epa.gov/quality.

Reference
Muhammad, N., Gallardo, V. J., Schupp, D. A., Krishnan, E. R., Minamyer, K. S., & Rice, E. W. (2013). Inactivation of Bacillus spores in decontamination wash down wastewater using chlorine bleach solution. *Canadian Journal of Civil Engineering*, *41*(999), 40-47.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-15

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Tech Support on Persistence of
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec 3 #3

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full Title: Technical Support for Research on Persistence of Contamination of Wastewater Infrastructure

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
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Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2015		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee:	LOE:
Cumulative Approved:	Cost/Fee:	LOE:

Work Assignment Manager Name: Jeff Szabo (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2823 FAX Number: 513-569-7052
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: **0-15**

TITLE:
Technical Support for Research on Persistence of Contamination on Wastewater Infrastructure

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
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National Homeland Security Research Center
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ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
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National Homeland Security Research Center
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Phone: 513-487-2814
email: hall.john@epa.gov

PERIOD OF PERFORMANCE:
June 1, 2014 until May 31, 2015

BACKGROUND:
EPA's National Homeland Security Research Center has a need for data on chemical, biological and radiological contaminant persistence on wastewater infrastructure. Contamination could enter a wastewater collection system through activities such as washing contaminated buildings or flushing contamination from a drinking water distribution system following an intentional contamination incident. Understanding which contaminants persist on wastewater infrastructure will help first responders make decisions about how to contain wash water or decontaminate infrastructure.

During a previous work assignment, the contractor constructed a pilot scale wastewater test bed capable of holding wastewater infrastructure materials and conditioning those materials in non-chlorinated secondary treated effluent (described as wastewater hereafter). The test bed was designed so that contamination can be introduced into the wastewater and contaminant persistence can be assessed on the coupon materials.

TECHNICAL SUPPORT:
The contractor shall provide support for monitoring sensor parameters in the test bed. This support will include monitoring water quality (pH, conductivity and temperature) and flow (flow rate, depth and velocity) for the duration of the work assignment. The contractor shall check that the sensors are providing reliable data on a daily basis during experimentation and troubleshoot

any sensor malfunctions. The contractor shall monitor the supply of wastewater entering the test bed and alert the WACOR if flow stops.

The contractor shall provide support for experiments conducted in the test bed. The contractor shall support placement of coupons in the test bed by attaching the coupons to the crossbar in each pipe using a binder clip and submerging the coupon in the flow. The coupons shall be conditioned in flowing wastewater in the test bed. After conditioning is complete, the contractor shall expose the coupons to a contaminant by introducing the contaminant into the channels at conditions determined by the WACOR. Contaminants will be chemical, biological (non-pathogenic) or a stable inorganic chemical that represents a soluble radionuclide (e.g. non-radioactive cesium chloride). Contaminants will be supplied by the WACOR through technical direction.

After the contamination period is complete, wastewater alone will once again be introduced to the test bed and allowed to flow past the coupons. Samples of infrastructure materials will be harvested before, during and after contamination so that contaminant persistence can be assessed. The contractor shall monitor contaminant persistence up to 7 days, but this time period could be longer depending on what is learned during the course of experimentation.

Once samples are harvested, the contractor shall place them into a 50 ml disposable conical tube filled with a stabilizing media determine by the WACOR through technical direction. The contractor shall ship these samples overnight to an outside laboratory. The contractor shall follow any necessary shipping procedures needed to ship coupons samples that have been in contact with wastewater.

Before experiments commence, the contractor shall organize and label sample bottles, fill the bottles with stabilizing buffer, and prepare shipping materials. The test bed will hold up to 240 coupon samples. During each experiment, there will be one intensive sampling period where the contractor shall remove and reinsert 20-40 samples within 15 minutes. Before and after this intensive sampling period, sampling will be sporadic and will include less than 30 samples per day. The intensive sampling period will be determined by the WACOR through technical direction

QUALITY ASSURANCE:
Sample analyses are not anticipated under this work assignment and a quality assurance project plan (QAPP) will not be written. The contractor shall note experimental parameters in the test bed such as wastewater flow rate, temperature, sampling times, contamination duration and contaminant concentration. The contractor shall also record all sample chain of custody information.

DELIVERABLES:
The contractor shall deliver a report summarizing the water quality parameters, flow rate, flow depth and flow velocity in the test bed to the WACOR at the conclusion of each experiment. Successfully sending samples to the laboratory performing the sample analyses will also be considered a deliverable.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-15

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Persist of Contamination Waste
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Section 3, paragraph 3

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full title: Technical Support for Reseach on Persistence of Contamination on Wastewater Infrastructure. The purspose of this amendment is to add two (2) more experiments in the wastewater test bed according to the original PWS.

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (*Max 2*) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
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Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2015		387
This Action:		183
Total:		570

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee:	LOE:
Cumulative Approved:	Cost/Fee:	LOE:

Work Assignment Manager Name Jeff Szabo (Signature) (Date)	Branch/Mail Code: Phone Number 513-487-2823 FAX Number: 513-569-7052
Project Officer Name Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT
EPA Contract: EP-C-14-012
Work Assignment: **0-15, Amendment 1**

TITLE:
Technical Support for Research on Persistence of Contamination on Wastewater Infrastructure

WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
Jeff Szabo
U.S. Environmental Protection Agency
National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-487-2823
email: szabo.jeff@epa.gov

ALTERNATE WORK ASSIGNMENT CONTRACTING OFFICER REPRESENTATIVE (WACOR):
John Hall
U.S. Environmental Protection Agency
National Homeland Security Research Center
Cincinnati, Ohio 45268
Phone: 513-487-2814
email: hall.john@epa.gov

PERIOD OF PERFORMANCE:
June 1, 2014 until May 31, 2015

BACKGROUND:
EPA's National Homeland Security Research Center has a need for data on chemical, biological and radiological contaminant persistence on wastewater infrastructure. Contamination could enter a wastewater collection system through activities such as washing contaminated buildings or flushing contamination from a drinking water distribution system following an intentional contamination incident. Understanding which contaminants persist on wastewater infrastructure will help first responders make decisions about how to contain wash water or decontaminate infrastructure.

During a previous work assignment, the contractor constructed a pilot scale wastewater test bed capable of holding wastewater infrastructure materials and conditioning those materials in non-chlorinated secondary treated effluent (described as wastewater hereafter). The test bed was designed so that contamination can be introduced into the wastewater and contaminant persistence can be assessed on the coupon materials.

TECHNICAL SUPPORT:
The contractor shall provide support for monitoring sensor parameters in the test bed. This support will include monitoring water quality (pH, conductivity and temperature) and flow (flow rate, depth and velocity) for the duration of the work assignment. The contractor shall check that the sensors are providing reliable data on a daily basis during experimentation and troubleshoot

any sensor malfunctions. The contractor shall monitor the supply of wastewater entering the test bed and alert the WACOR if flow stops.

The contractor shall provide support for experiments conducted in the test bed. The contractor shall support placement of coupons in the test bed by attaching the coupons to the crossbar in each pipe using a binder clip and submerging the coupon in the flow. The coupons shall be conditioned in flowing wastewater in the test bed. After conditioning is complete, the contractor shall expose the coupons to a contaminant by introducing the contaminant into the channels at conditions determined by the WACOR. Contaminants will be chemical, biological (non-pathogenic) or a stable inorganic chemical that represents a soluble radionuclide (e.g. non-radioactive cesium chloride). Contaminants will be supplied by the WACOR through technical direction.

After the contamination period is complete, wastewater alone will once again be introduced to the test bed and allowed to flow past the coupons. Samples of infrastructure materials will be harvested before, during and after contamination so that contaminant persistence can be assessed. The contractor shall monitor contaminant persistence up to 7 days, but this time period could be longer depending on what is learned during the course of experimentation.

Once samples are harvested, the contractor shall place them into a 50 ml disposable conical tube filled with a stabilizing media determined by the WACOR through technical direction. The contractor shall ship these samples overnight to an outside laboratory. The contractor shall follow any necessary shipping procedures needed to ship coupons samples that have been in contact with wastewater.

Before experiments commence, the contractor shall organize and label sample bottles, fill the bottles with stabilizing buffer, and prepare shipping materials. The test bed will hold up to 240 coupon samples. During each experiment, there will be one intensive sampling period where the contractor shall remove and reinsert 20-40 samples within 15 minutes. Before and after this intensive sampling period, sampling will be sporadic and will include less than 30 samples per day. The intensive sampling period will be determined by the WACOR through technical direction

In this amendment, the number of experiments conducted will be increased. From June 1 to September 30, 2014, three experiments were conducted in the wastewater test bed according to the original SOW. Under this amendment, two additional experiments will be conducted between the date of issuance of the amended work assignment and May 31, 2015. Each of the two new experiments planned under this amendment will be conducted in a manner similar to each of the three individual experiment conducted under the original WA 0-15. Therefore, it is expected that the level of effort needed to complete the two additional experiments will be two-third of the effort needed to complete the first three experiments.

QUALITY ASSURANCE:
Sample analyses are not anticipated under this work assignment and a quality assurance project plan (QAPP) will not be written. The contractor shall note experimental parameters in the test bed such as wastewater flow rate, temperature, sampling times, contamination duration and contaminant concentration. The contractor shall also record all sample chain of custody

information.

DELIVERABLES:
The contractor shall deliver a report summarizing the water quality parameters, flow rate, flow depth and flow velocity in the test bed to the WACOR at the conclusion of each experiment. Successfully sending samples to the laboratory performing the sample analyses will also be considered a deliverable.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-16

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Evaluation of Effectiveness of
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec 3, #1, ; Sec 5

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
full title: Evaluation of the Effectiveness of UV disinfection over time for Inactivation of Waterborne pathogens in Surface and Ground water supplies in Non-PRASA Communities in Puerto Rico

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
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Authorized Work Assignment Ceiling

Contract Period: 06/01/2014 To 05/31/2015 — Cost/Fee: — LOE:

This Action:

Total:

Work Plan / Cost Estimate Approvals

Contractor WP Dated: — Cost/Fee: — LOE:

Cumulative Approved: — Cost/Fee: — LOE:

Work Assignment Manager Name: Craig Patterson (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2805 FAX Number: 513-569-7052
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

Performance Work Statement
EPA Contract No.: EP-C-14-012
Work Assignment: 0-16

I. Title: "Evaluation of the Effectiveness of UV Disinfection over Time for Inactivation of Waterborne Pathogens in Surface and Groundwater Supplies in Non-PRASA Communities in Puerto Rico"

II. Work Assignment COR:

Craig L. Patterson, P.E.
Water Quality Management Branch
Water Supply and Water Resources Division
U.S. EPA National Risk Management Research Laboratory
Cincinnati, Ohio 45268
Phone: 513-487-2805
email: patterson.craig@epa.gov

III. Period of Performance: June 1, 2014 to May 31, 2015

Background:

Community health problems can result from Total Coliform Rule MCL violations and Surface Water Treatment Rule Treatment Technique violations. Isolated rural communities suffer chronic problems such as coliform and pathogen contamination in source waters. There exists a significantly higher potential for epidemic outbreaks of enteric diseases in these communities (e.g., typhoid and paratyphoid fever, cholera, amoebic and bacillary dysentery, viral gastroenteritis, and giardiasis). The potential for epidemic outbreaks is very real and cannot be ignored.

According to a survey conducted by the Departamento de Salud-Division de Agua Potable-Inventario Sistemas Non-PRASA (2012), Puerto Rico has 247 public water systems outside of Puerto Rico Aqueduct and Sewer Authority (PRASA) control with 147 of these systems serving between 100 and 500 people. Many of these systems use source waters that are contaminated by human and animal wastes. Yet, only 186 of the 247 systems use some form of chlorination and very few of them use filtration technologies for removal of chlorine resistant pathogens. UV disinfection in combination with chlorination provides a low cost alternative for disinfection of pathogens and chlorine resistant pathogens in the absence of filtration technologies. There is a very clear need for a multi-barrier approach to provide safe water and improve the health of individuals living in communities served by the non-PRASA systems.

The objective of this RARE project is to provide a concept for sustainable water that will improve the health and welfare of consumers in remote communities in Puerto Rico. The positive effects of the sustainable improvements will be shown by demonstrating that pretreatment in combination with UV disinfection and chlorination will inactivate pathogens over time.

Technical Approach:
The goal of this research project is to find a solution to the problem of pretreatment and disinfection for those small rural communities with drinking water supplies in a tropical climate, so they can reduce their risks for waterborne disease and comply with the Safe Drinking Water Act regulations. To achieve this goal, EPA proposes a collaborative research study with a major university in Puerto Rico investigating disinfection technologies for surface and ground water supplies. The idea is not to only benefit small rural Puerto Rican communities, but also to develop a concept or approach that can be implemented in other communities in tropical regions. The contractor shall provide the following support:

Task 1 – Prepare a work plan
Task 2 – Update the quality assurance and health and safety project plans
Task 3 – Technical support for sand filtration system
Task 4 – Conference presentation

Task 1 – Prepare a work plan
A work plan to complete the tasks outlined in this statement of work shall be prepared and submitted in accordance with the contractual schedule for this deliverable. The proposed work plan shall set the contractor's approach, staffing, schedule, milestones, and estimated budget for the completion of the tasks.

Task 2 – Update the quality assurance and health and safety project plans
The quality assurance project plan (QAPP) and health and safety project plan (HASP) shall be updated, as necessary, to reflect ongoing research efforts. The awardee shall comply with all requirements as delineated on the "Quality Assurance Planning Requirements Form" included with this extramural action.

Task 3 – Technical support for sand filtration system
The contractor shall procure appropriate plumbing supplies for setup and operation of a sand filter for installation in La Sophia, Puerto Rico. The contractor shall ship the sand filter and plumbing supplies to a major university in Puerto Rico. The contractor shall provide technical support for installation of the sand filtration system by University students.

Task 4 – Conference Presentation
The contractor shall attend and present findings from the research identified in this WA in form of a presentation at EWRI 2014 conference in Portland, Oregon. All travel must be approved by the CL-COR in accordance with the contract clause. The contractor shall provide all Work Assignment deliverables in both PDF and the original source format (e.g., Microsoft Word, Powerpoint, Excel).

VI. Reporting;

A. Monthly Reports:

Monthly reports summarizing the status of the Work Assignment shall be completed and provided to the EPA CL-COR as part of the Work Assignment deliverables. The monthly reports shall;

- Summarize the work accomplished under ongoing individual tasks
- Provide milestones and deliverables achieved
- Summarize the planned activities anticipated for the upcoming period,
- Identify problems and resolutions encountered

The WACOR shall utilize the Monthly Reports to:

- Evaluate the status and the progress of the work
- Resolve technical and/or budgeting problems
- Identify and demonstrate expenditures

B. Project Meetings:

Project meetings shall be conducted as needed to assure the completion of the research efforts. The contractor shall provide, at a minimum, the following up-to-date information at each meeting;

- Planned activities for the upcoming period
- Status and progress of the research
- Problems encountered and resolutions
- Budget information

The contractor shall provide all project management information in hard copy and electronic format. The contractor shall summarize project meetings and submit to the WAM in the most up-to-date version of Microsoft Word format with in five (5) working days of the project meeting. Summary of the project meetings can be provided via E-mail.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-16

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Effectiveness of UV disinfecti
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Section 3 Paragraph 1, Section 5

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full title: Effectiveness of UV Disinfection in Puerto Rico
The purpose of this amendment is to add Task 5 to this work assignment 0-16.

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
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Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2015		112
This Action:		248
Total:		360

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Craig Patterson (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2805 FAX Number: 513-569-7052
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-17

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Technical Support to Improve W
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec 3; #1, 3, 4

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full Title: Technical Support to Improve WQ Modeling and WQT.

[ ] Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): [ ]

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
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3										
4										
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Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2015		0
This Action:		3,462
Total:		3,462

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee:	LOE:
Cumulative Approved:	Cost/Fee:	LOE:

Work Assignment Manager Name: Matt Heberling (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7917 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

PERFORMANCE WORK STATEMENT

EPA Contract No. EP-C-14-012

Work Assignment: WA-00-17

Title: Continuation of Technical Support for Research to Integrate Watershed/Waterbody Ecodynamics and Engineered-System Processes for Effective Water Quality Forecasting and Water Quality Trading.

Work Assignment Contracting Officer's Representative (WA COR)
Matt Heberling
U.S. Environmental Protection Agency
National Risk Management Research Laboratory
Cincinnati, OH 45268
AWBERC office: 513-569-7917
Email: heberling.matt@epa.gov

Alternate WA COR:
Chris Nietch
U.S. Environmental Protection Agency
National Risk Management Research laboratory
Cincinnati, OH 45268
ESF office: 513-965-4805; AWBERC office: 513-569-7460; CELL: 513-317-9394
Email: nietch.christopher@epa.gov

Period of Performance: July 15, 2014 to May 31, 2015

Background:

In 2010, Shaw Environmental and Carnegie Mellon University developed a framework for linking watershed landscape properties and processes to water quality, and then to the performance of a drinking water treatment plant. With the modeling framework, EPA began to answer the following question:

Is water quality trading feasible in the East Fork Watershed?

The previous work did not include cost estimates of the different controls or a financial assessment of water quality trading which was the goal of the work assignment that began in 2012. In addition, we continued the SWAT modeling efforts to fully understand nutrient control options available to agricultural producers and point sources. From these activities, we have a better idea of the potential supply and demand of water quality credits in the East Fork. In addition, we have started to examine the incentives that may exist for a drinking water treatment plant in the water quality-trading program. The previous work assignment had three broad tasks. The first task continued the line of research wherein EPA requires understanding the potential demand and supply of credits for wastewater

treatment plants and agricultural producers. The second task supported the SWAT model runs for estimating the load reduction possibilities, uncertainties and sensitivity analyses. The final task expanded the list of potential participants beyond wastewater treatment plants and agricultural producers. We wanted to look at the drinking water treatment plant located on East Fork Lake and septic systems.

Combining the outputs from these tasks, we will then be able to determine whether water quality trading is feasible based on the potential participants and their abatement costs. We have estimates of the potential supply and demand of credits.

This new work assignment continues the line of research by completing certain subtasks from the previous work assignment and updating data sets. The research has four broad tasks: SWAT model runs and updates and lake model runs; Statistical analysis for spatial stream network (SSN) modeling; Data acquisition, data entry, database development and management, and statistical support to estimate cost models and spatial models; and support, review, and edit journal articles, reports, or other summaries.

Important References for Work

CTIC (Conservation Technology Information Center). 2011. WABASH RIVER BASIN WATER QUALITY TRADING FEASIBILITY STUDY. Accessed at: http://www.ctic.org/media/pdf/TWG/Wabash%20WQT%20Feasibility%20Study_091411_final%20report.pdf

Feng, H., Manoj, J., Gassman, P. 2009. "The allocation of nutrient load reduction across a watershed: Assessing delivery coefficients as an implementation tool." Applied Economic Perspectives and Policy 31, 183-204.

Heberling, M. et al. 2014. "Examining a drinking water treatment plant's incentive for purchasing nutrient abatement: Comparing treatment and source water protection costs for the Bob McEwen Water Treatment Plant, Batavia, OH." Working Paper.

Isaak, D., E. Peterson, J. Ver Hoef, S. Wenger, J. Falke, C. Torgersen, C. Sowder et al. Applications of spatial statistical network models to stream data." Wiley Interdisciplinary Reviews: Water 1, 277-294.

McGuire, K., C. Torgersen, G. Likens, D. Buso, W. Lowe, and S. Bailey. 2014. "Network analysis reveals multiscale controls on streamwater chemistry." Proceedings of the National Academy of Sciences 111, 7030-7035.

USEPA. 2007b. Water Quality Trading Toolkit for Permit Writers. United States Environmental Protection Agency, Office of Water, Washington, D.C. EPA-833-R-07-004. August 2007.

In particular, see Appendix F, Trading with Subsurface Septic Systems (Added June 2009). Pp. F1-F10. Accessed at: http://www.epa.gov/npdes/pubs/wqtradingtoolkit_app_f_trading_septic.pdf

USEPA. 2014. "Modeling Watersheds for Water Quality Trading Analysis – The East Fork Watershed Case Study." Draft Report.

Task Schedule

Task A SWAT model runs, updates, and lake model runs. **Task A** has a number of subtasks that may require a variety of expertise to address adequately. The Contractor shall write short summaries, in lieu of a final report, outlining steps of: exploratory data analysis, model fitting, residuals and diagnostics, model selection, and prediction. The Contractor shall provide code, output, data, and results for each Subtask when completed.

Subtask A.1: The Contractor shall complete the calibration and validation for the SWAT model for both the Upper and Lower East Fork Watershed. This shall include addressing any remaining issues with the land use/septic's layer and point source data for the most recent years. The Contractor shall develop and run uncertainty analyses for the Upper and Lower East Fork Watershed. If deemed necessary, the Contractor shall utilize a different optimization algorithm that takes longer to run than SUFI-2 but focused on a smaller scale. This activity shall depend on how well the SUFI-2 algorithm works for both the Upper and Lower East Fork Watershed for estimating confidence intervals.

Subtask A.2: With a calibrated and validated SWAT model, the Contractor shall use the SWAT model to estimate transfer or delivery coefficients. Delivery coefficients represent the proportion of a farm's nutrient load delivered to a downstream source (USEPA 2007). One approach in the literature is based on Feng et al. 2009 (reference above).

Subtask A.3: The Contractor shall update or alter BMP modeling scenarios (multiple). At a minimum additional scenarios shall be developed that simulate a wetland-like feature and possibly green infrastructure. Review literature for latest SWAT modeling conventions for agricultural BMPs and if time permits stormwater BMPs (referred to as green infrastructure or GI). Implement new parameterizations as appropriate and re-run model. Wetlands and residue management modules may be improved by SWAT developers during this option period; running these scenarios with the updated version shall be included in this subtask. Once scenarios are validated, mock trade scenarios shall be run to determine if changes in nutrients can be seen at the wastewater treatment plants. These mock trade scenarios shall consist of examining the effect of a BMP above a wastewater treatment plant to see if a target can be met at the wastewater treatment plant. Another scenario shall consist of two realistic agriculture land area spatial applications of BMPs to test whether water quality targets could be met with two potential agriculture producers' participation rates (e.g., 10% and 25% depending on our agriculture experts' opinions about participation rates in water quality trading). The Contractor shall run uncertainty analyses on these scenarios as well based on EPA's need for such analyses.

Subtask A.4: The Contractor shall manage data and conduct procedures for multiple runs of SWAT Model including managing data output at multiple spatial scales. Hydrologic and constituent loading data will be required for each field site in the 2013 EFWS monitoring program (40 sites minimum), at HUC 12 pourpoints, and any other subwatershed outlets that our partner OEPA requests information for TMDL development and implementation. The contractor shall keep the SWAT Model updated on a 6-month basis with the next update bringing the model current to 09/30/2014.

Subtask A.5: A Lake Model developed by the US Army Corp is available for this option period. It is based on the CE-QUAL-2W model. The Contractor shall develop a plan to use this model to improve our ability to predict changes in nutrients at the Drinking Water Intake and compare the results to the SWAT model results. The Contractor shall implement the plan to begin Lake Model runs. Data acquisition for **Subtask A.5** is described below.

Task B Statistical analysis for spatial stream network (SSN) modeling of the East Fork Watershed
This task consists of modeling spatially continuous stream networks that incorporate auto correlated errors based on a generalized linear mixed model framework so that prediction (kriging) or block predictions (block kriging) can be done on biotic and water chemistry data at the watershed scale (McGwire et al. 2014; Isaak et al. 2014). In order to complete this task, expertise in environmental engineering or hydrology and experience with ArcGIS, Python, R, and monitoring data are necessary. The Contractor shall use the SSN R package, and other suitable R packages, for exploratory data analysis (such as checking for collinearity among the covariates), model fitting, residual diagnostics, and model selection to determine the best non-spatial model. For example, the Contractor may be asked to estimate and compare non-spatial multiple linear regression models for biotic, nutrient or water chemistry data as a function of land use variables, soil types, and slope categories. These non-spatial regression models may include dummy variables to represent upstream or downstream of Lake Harsha. Other variables to evaluate if they improve the best non-spatial model include accumulated watershed variables. The Contractor shall document the steps used for analysis, how the model was selected, R code, and output from R code. Other documentation may be requested via technical direction by EPA. Using the non-spatial regression models, the Contractor shall fit and compare SSN models having different spatial covariance structures. Through technical direction from EPA, the Contractor shall use the best fitting SSN model to make spatial predictions at unsampled sites. For example, the Contractor may be asked through technical direction to use biotic, nutrient, and/or water chemistry data regression models to estimate SSN models with different covariance structures. Using statistical diagnostic tests, the Contractor shall choose the best model to predict concentrations at sites that do not have data. Using ArcGIS, the Contractor shall produce maps showing the prediction and prediction errors of the SSN models for the East Fork Watershed. The Contractor shall provide an R markdown file in html that documents how the final SSN model was selected, along with R code, output from the R code, and comments on the analysis outlining steps of: exploratory data analysis, model fitting, residuals and diagnostics, model selection, and prediction. The data set used for the analysis shall be included with the output.

Task C Data acquisition, data entry, database development and management, and statistical support to estimate cost models and spatial models. Drinking water treatment plant data from 2012 and 2013 was acquired from the County and US Army Corp during the previous work assignment. This data shall be entered into a spreadsheet that can be used in modeling the costs of drinking water treatment and match the same variables used for the previous 5 years of daily data. The Contractor shall update additional variables as necessary for the cost model. For example, Chlorine Free and Chlorine Demand are currently available from 2007-2013, but the data are only available from the paper logs and records for years 2007-2008 and 2012-2013. In addition to data for the drinking water treatment model, data for estimating property values (i.e., hedonic models) shall be acquired. The Contractor has provided a spreadsheet with much of this data during a previous work assignment, but other variables may be needed to supplement the data set. The Contractor shall be asked to acquire property attributes in the East Fork Watershed (number of bathrooms, number of bedrooms, sale price) and water quality variables near the properties to support an estimation of a hedonic model if time permits. **Subtask A.5** has a data acquisition component to run. CE-QUAL-W2 requires reservoir bathymetry, initial conditions, inflow quantity, and quality including water temperatures, outflow quantity, and outlet description. The model require time series of inflow rates and water quality, meteorological data, and water surface elevations. During the period of performance, EPA may need statistical support in terms of interpretation of results and tests rather than guiding EPA on best methods for analyzing data. Based on EPA's needs, the Contractor shall provide statistical support and statistical modeling support for **Task A** related to understanding measures of uncertainty and how well the model predicts. The Contractor shall provide support related to spatial modeling for **Task B**. The Contractor shall provide statistical support for cost models including interpretation of time series analyses, diagnostic tests, and property value models (i.e., spatial aspects of property values). Database management expertise is a key component of this task.

Task D Support, review, and edit journal articles, reports or other summaries. The first activity under this task shall be to edit and revise the draft report titled, "Modeling Watersheds for Water Quality Trading Analysis – The East Fork Watershed Case Study." EPA will provide comments to the Contractor at the kickoff meeting for this WA. The contractor will have a month to review the draft report. In addition, the Contractor shall be asked to examine the written products if they are listed as co-authors with EPA. During this option period, EPA is planning to complete three journal articles. The writing of the journal articles will be led by EPA and the Contractor shall review the journal articles. The Contractor shall review Heberling et al. (2014) as the first journal article under this option (reference above). As mentioned in **Task A**, EPA is not requesting a final report for this work assignment. Rather, EPA is requesting summaries of activities throughout the work assignment as described above.

TECHNICAL DIRECTION

Technical direction will be provided by the WA COR or alt COR in the form of e-mails or written meeting minutes. If meeting minutes are written by others, the WA COR will provide e-mail confirmation that

direction provided therein is authorized. The WA COR will facilitate access to existing research infrastructure and data specific to the outlined scientific objectives. The Contractor shall be responsible for the final data analyses and write-up of the project's results. The WA COR will provide written review and comments to write-ups delivered at the end of each task period outlined above.

SCHEDULE AND DELIVERABLES

Technical Briefs shall be included in the monthly reports of general activities at the end of each of the subtasks identified above. These shall be delivered no later than the final date for the period defined for each task. These could be delivered in the form of bulleted lists or in outline format; they are not meant to be intrusive to the overall process, more like a running 'notes' file to expedite the writing of the modeling summaries.

The Contractor's agents and/or Project Lead will meet with EPA on a monthly basis to discuss all on-going and planned aspects of the research identified. The WA COR will meet with the Contractor's Senior Engineer/Scientists weekly to ensure project timelines are being met. All verbal communications may be conducted via teleconference. Any adjustments required to the timeline will be mutually agreed upon during these periodic meetings and any changes shall be approved via written communication to the Project Manager.

Data generation associated with the project objectives will be entered in the ESF/EFWS data files in accordance with the QAPP (634-Q-2-0) or based on technical directives from the WA COR.

QUALITY ASSURANCE STATEMENT

The Contractor shall comply with the QA/QC requirements outlined for data management and modeling in the endorsed QAPP (W-16434-QP-1-0/S-11846 [for STD QA tracking]): "Simulation Modeling in Support of Determining the Feasibility of Water Quality Trading in the Upper East Fork Watershed" written by the EPA. The plan covers the minimum requirements for documenting the data quality and methods associated with model development, procedures for model calibration, model sensitivity analysis, and model validation. When necessary for determining data quality for model parameterization, calibration and testing, the Contractor shall comply with the QA/QC requirements outlined in the endorsed QMP/QAPP (634-Q-2-0): "Experimental Stream Facility and East Fork Watershed Study: Research Linking Land Use Management Practices to Ecological Structure and Function in Small Stream Ecosystems" written by the EPA; specifically, the Addendum written by Dr. Nietch that includes 2011 projects. This is an 'umbrella' plan that covers the activities of EPA-PI's, its contractors, and collaborating partners in ESF/EFWS research.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-17

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2019	
	Base X Option Period Number	

Contractor: CB&I FEDERAL SERVICES LLC

Specify Section and paragraph of Contract SOW:

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
06/01/2014 To 05/31/2019		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Matt Heberling (Signature) (Date)	Branch/Mail Code:	
	Phone Number: 513-569-7917	
	FAX Number:	
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code:	
	Phone Number: 513-569-7920	
	FAX Number:	
Other Agency Official Name (Signature) (Date)	Branch/Mail Code:	
	Phone Number:	
	FAX Number:	
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code:	
	Phone Number: 513-487-2351	
	FAX Number: 513-487-2109	

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 0-24

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-14-012	06/01/2014 To 05/31/2015	Occurrence of Selected Contam
	Base X Option Period Number	

Contractor	Specify Section and paragraph of Contract SOW
CB&I FEDERAL SERVICES LLC	Sec 3 Item #1-5

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 06/01/2014 To 05/31/2015

Comments:
Full title: Occurrence of Selected Contaminants of Emerging Concern (CECs): In Natural and Treated Waters

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period: 06/01/2014 To 05/31/2015 — Cost/Fee: — LOE:

This Action:

Total:

Work Plan / Cost Estimate Approvals

Contractor WP Dated: — Cost/Fee: — LOE:

Cumulative Approved: — Cost/Fee: — LOE:

Work Assignment Manager Name: Kathleen Schenck (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7947 FAX Number:
Project Officer Name: Ruth Corn (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7920 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Mark Cranley (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2351 FAX Number: 513-487-2109

Performance Work Statement

Title: Occurrence of Selected Contaminants of Emerging Concern (CECs): In Natural and Treated Waters

Period of Performance: June 1, 2014 through May 31, 2015

Contract Number: CP-C-14-012

Work Assignment Number: 0-24

Research Location: U.S. EPA, 26 W. Martin Luther King Dr., Cincinnati, Ohio 45268

Background:

The identification and management of health risks is an important priority of the US EPA. Many of the chemicals identified as contaminants of emerging concern (CECs), including endocrine disrupting compounds (EDCs), pharmaceuticals, personal care products, pesticides, etc., have been detected in surface, ground, and finished drinking waters, due primarily to their introduction from domestic and industrial sewage treatment systems and wet-weather runoff. The presence of these contaminants has led to concerns over the potential human and ecological health risks that may be associated with them, such as reproductive impairment, increased incidences of cancer, and development of antibiotic resistant bacteria. The prevalence of these concerns is evident in the numerous reports in the popular print and broadcast media regarding the potential health risks posed by these contaminants in natural and finished drinking waters.

The Water Supply and Water Resources Division, NRMRL, is evaluating the occurrence of selected CECs within the environment and/or following various water treatment processes. The target analytes will include, but are not limited to, EDCs, pharmaceuticals, personal care products, algal toxins, anthropogenic markers and pesticides. Selected samples will be evaluated for possible biological effects. Water samples may also be evaluated for the presence of transformation/degradation products of these contaminants that may occur within the environment and/or following various treatment processes.

Technical Approach:

The contractor shall furnish personnel, services and supplies necessary to support research to evaluate the occurrence of selected contaminants in surface, ground, and/or treated waters. The surface, ground and treated water samples will be either provided to the contractor by EPA or the contractor may be responsible for sample collection. Treatability studies may be conducted at bench-scale, pilot-scale or full-scale. In addition to removal, these studies may also evaluate transformation, degradation, adsorption, etc. of the contaminants by various processes used in water treatment (e.g. wastewater and drinking water treatment).

The evaluation of the occurrence of selected contaminants will be based primarily on analytical analyses. Selected samples will also be evaluated for endocrine activity using a bioassay(s). The contractor shall be responsible for sample preparation and the analytical identification and quantification of the selected contaminants in the samples. Sample preparation and analysis may be conducted using previously developed methods or new methods developed by the contractor. The contractor shall also be responsible for sample preparation in support of the bioassay work and/or additional analytical analyses to be

performed by EPA personnel (or other individuals).

Technical support shall be provided by the contractor, as needed, for treatability studies, conducted at bench, pilot or full-scale. The contractor shall be responsible for providing chemicals, supplies, collection of samples, transport of samples and/or water, etc. as required to carry out the studies. Technical direction regarding sample collection, sample preparation, chemical analyses, method development and/or treatability studies will be provided by the EPA Work Assignment Contracting Officer Representative (WACOR).

Tasks to be performed under this Performance Work Statement shall include the following:

1. The contractor shall be responsible for sample preparation and the analytical identification and quantification of selected contaminants in water samples, primarily by ultra-high performance liquid chromatography/triple-quadrupole mass spectrometry (UPLC/MS/MS). The contractor shall be responsible for sample preparation in support of bioassay work and/or additional analytical analyses to be performed by EPA personnel (or other individuals). The contractor may use previously developed methods or may need to develop new methods, dependent upon the needs of the research (e.g. the addition of new analytes or matrices, new instrumentation, etc.). The contractor shall conduct evaluations of precision and accuracy for the analytical methods being used by the contractor as required by the needs of the research. The contractor shall provide support (such as sample preparation) as needed for evaluations of precision and accuracy for bioassay/analytical methods being conducted by EPA personnel. The contractor may conduct/support the analysis/characterization of samples to evaluate possible transformation/degradation of selected analytes, matrix components, etc. that may occur within the environment and/or following various treatment processes. The contractor shall be responsible for determining the most appropriate methods of stabilization/preservation and quenching of residual disinfectant(s) (if applicable) for water samples between collection and analysis, if required, and/or develop a method for verification of sample integrity for the holding times needed by the research. Samples will be prepared and analyzed by the contractor within the hold times stated in the methods, given functional equipment and instrumentation. If EPA delivers a set of samples such that there is not adequate time available for sample prep and/or analysis, the contractor will not be held responsible for meeting hold times for the sample set.

   The water samples will be from several research projects, focusing on environmental occurrence, treatment, or a combination of both. The environmental occurrence studies will be collecting water samples from sites within the Watershed of the East Fork of the Little Miami River and selected USGS surface water sampling sites throughout the U.S. Most of the treatment study samples will be from a bench-scale study evaluating biodegradation of selected contaminants. Multiple sample sets will be generated by a study designed to follow CECs from wastewater effluents, through downstream dilution, to intake and full-scale drinking water treatment. Most of these samples require extensive sample preparation (solid phase extraction and derivatization) prior to analytical analysis. In addition to the time required for sample preparation and analyses, time will be needed to develop new methods due to the addition of new analytes, matrices and/or instrumentation.

2. The contractor shall comply with and/or implement approved Quality Assurance Project Plans (QAPPs), all associated SOPs (Standard Operating Procedures) and Health and Safety Plans (HASPs). QAPPs and HASPs will be submitted, reviewed and approved by EPA. The contractor may be requested to provide technical expertise as needed, such as preparation/review of SOPs.

All QAPPs must be consistent with the quality assurance planning requirements for NRMRL projects in the Basic Research category. (see attached QARF)

3. A working file of all reference materials/information associated with all aspects of this research will be maintained for the duration of the project(s) by the contractor. These references shall be available to EPA upon request by the WACOR.

4. The contractor shall provide to EPA test compounds, supplies, technical assistance, shipment services, collection of samples, etc., as needed for EPA to evaluate the occurrence of selected contaminants within the environment and/or following various water treatment processes. The contractor shall provide EPA with all analytical results for all samples as well as appropriate supporting QA documentation.

5. The contractor shall provide sample collection, preservation of samples, analyses, etc. to obtain water quality data (e.g. total organic carbon, turbidity, pH, disinfectant residuals, etc.) as requested by EPA.

6. The contractor shall provide transport of samples, supplies, etc. between the EPA AWBERC facility, T&E facility, or other water sources and/or facilities as required by the research. The contractor shall be responsible for sample collection, sample pick-up, transfer, packing and shipping, and delivery of all samples to the appropriate laboratories for analyses and QA compliance as needed. The contractor shall be responsible for stabilization/preservation and quenching of residual disinfectant(s) (if applicable) of all samples between collection, shipping, and analysis with respect to the test compounds when appropriate. The contractor shall be responsible for providing all other preservatives, stabilizers and/or quenching agents as may be required by the research, e.g. those required for the water quality analyses. The contractor shall be responsible for providing appropriate sample bottles, vials, sample labeling, chain-of-custodies (COCs), packing materials, and shipping and handling devices when needed. The contractor shall be responsible for procuring, tracking, and disposing of any and all chemicals/samples used to conduct the research.

7. The contractor shall investigate, when appropriate, potential biological or chemical alteration of the parent compounds within the environment and/or following treatment. The scope of any such investigation shall be determined in consultation with the EPA WACOR.

8. The contractor shall provide monthly reports on all aspects of the project(s). Additional meetings and reporting may be requested, on an as needed basis, by the WACOR to determine the progress of the project(s) and/or achievement of interim experimental goals. The contractor shall provide written materials, graphs, data analyses, slides, etc. on an as needed basis, as determined by the WACOR, to be used in presentations, publications, etc. regarding the progress/results of the project(s).